# POWER

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# An Off Day

DO YOU ever get up out of the wrong side of the bed into one of those days when everything goes wrong and everything, animate and inanimate, seems to be in a conspiracy against you?

The fire is low, the house is cold, your razor is dull, you cannot find things, your scarf won't tie, your breakfast is disappointing, you lose your train, the paper is full of irritating news, people jostle you and everybody seems preoccupied and surly.

The fire has been low before, but you went down and shook it up. The razor was just as sharp as it was the last time you had used it before. There were good things about the breakfast but you let the departures from your ideal add to your growing irritation. It was the same old necktie obedient to the same patient manipulation as usual, but bound to go awry under twitching and yanking and utterly oblivious of curses.

The train was not ahead of time. Your disordered mental condition made you less orderly about your departure. The apparent lack of friendly greeting in those you met was a natural reaction to your own surly humor.

I suppose we are all, some of us more than others, subject to this kind of mental disorder. We are like the workman or official whose bench or desk has become so cluttered and confused that he can put his hand upon nothing that he wants and adds to the trouble by impatient ill-natured scrambling, losing time and temper with each succeeding effort.

There is no use in taking a day off and playing golf or fishing or driving your car. You will pile up your worst score, fumble your casts, tangle your lines, lose your fish and twitch your car off into the ditch.

The thing to do is to recognize that it is yourself and not everything and everybody else that is out of kilter.

Sit down and get the perversity out of your system by calling yourself to task rather than defaming and cussing other persons and things. Figuratively clean up that workbench or desk so that you can see your way clear. Then take a new start, and if a thing does not go off right find out why and fix it so that it will.

With each item that is successfully accomplished your control over yourself and your surroundings will improve and you will find that most of your difficulties and annoyances have been self-made or avoidable.

F. R. Low

# New England Textile Plant Operates On Powdered Fuel

## Installation of Uxbridge Worsted Co. a Pioneer in Boston District—Unit Pulverizers Used with Horizontal Return-Tubular Boilers—Operation Flexible and Efficient

ALTHOUGH several projects of this type are now under construction, powdered-fuel installations are still more or less of a novelty in New England, where adoption of this method of firing boilers has been somewhat slower than in the Central and Midwest States. This condition accounts for the great interest evinced by New England engineers and manufacturers, and particularly by textile experts of the Boston region, in the powdered-fuel installation now in operation at the plant of the Uxbridge Worsted Company.

Situated in the town of Uxbridge, between Boston and Worcester, this plant will afford a practical means of studying the commercial performance obtainable with powdered coal under the existing conditions as to fuel, labor, etc., in the textile district surrounding Boston.

The comparative slowness with which powdered fuel has been adopted in New England may be due in part to New England's conservatism, but the fuel situation has been a contributing factor. One of the major claims made for powdered fuel is the ability to burn low-grade fuels with good efficiency. This argument has less weight in New England than in regions nearer the coal mines, for the reason that high freight rates practically prohibit the shipment of low-grade coal for any purpose. Such a condition, of course, does not hold during coal strikes.

These points were not overlooked when the Uxbridge Worsted Company installed powdered-fuel equipment in its new boiler house about a year and a half ago.

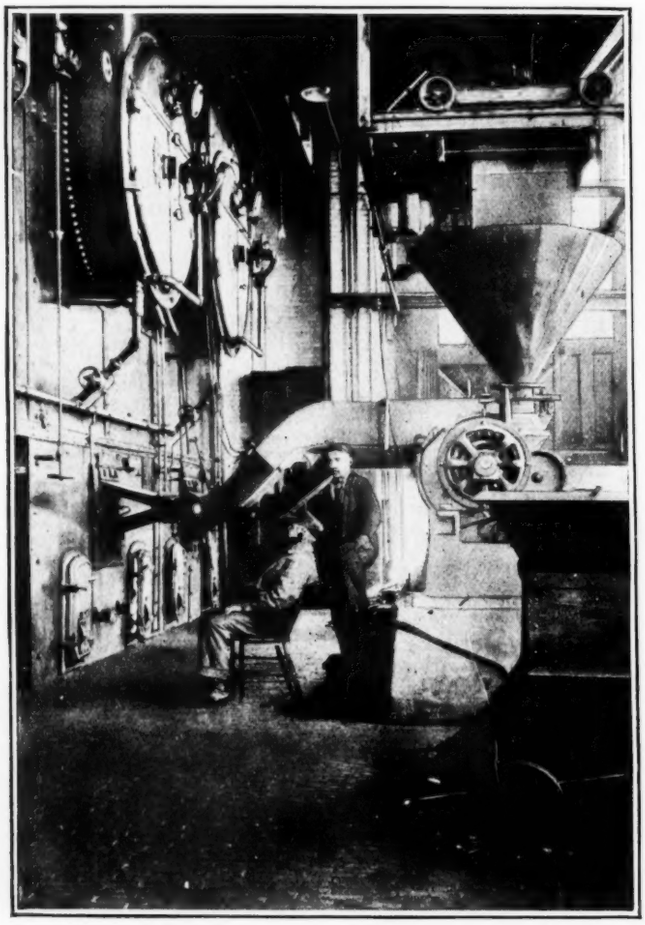


*Fig. 1—View of two boilers with individual pulverizers*

Above the pulverizer hopper may be seen an automatic coal weigher suspended from the crushed-coal bunker. To eliminate the possibility of dust leakage, welded pipe joints are used in the piping leading to the burners. The coal truck in the foreground is used in connection with the hand-fired reserve boiler. Light and ventilation are supplied by large windows and a monitor.

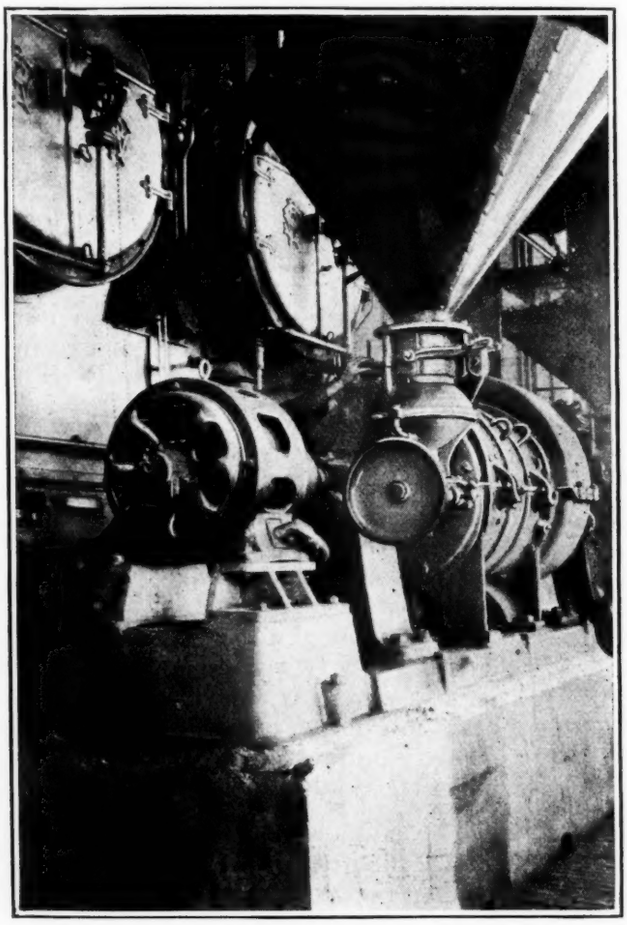


*Fig. 2—View of one pulverizer from the feed end*

Driven by a 30-hp. motor and mounted on a substantial concrete foundation, this pulverizer takes crushed coal of 1¼-in. size or finer, reducing it to a suitable fineness for rapid and complete combustion. A fan mounted at the farther end of the machine delivers to the furnace the proper amount of powdered coal mixed with about 60 per cent of the air needed for the combustion.

Of three 84-in. by 20-ft. horizontal-return tubular boilers installed, two were equipped with individual unit pulverizers. The third boiler, being intended for emergency use only, was arranged for hand firing.

The general appearance of the plant and arrangement of apparatus is clearly shown in the accompanying drawings and photographs.

Starting at the small unloading plant, consisting of a track hopper, bucket conveyor and 100-ton elevated pocket at the freight yards, coal is discharged into motor trucks by gravity, and hauled one-third of a mile to the boiler plant, where it is dumped into a concrete hopper. From this it is automatically fed to the steel boot of a V-bucket elevator, which delivers it through a rack-and-pinion gate over a chute to an elevated crusher. The crushed coal is fed to any desired coal bunker by a reversible shuttle belt conveyor.

A single set of automatic coal scales mounted on a suspended track beneath the bunkers delivers weighed coal to either of the two unit pulverizers or the coal truck for the hand-fired boiler.

The powdered coal, with its primary air, is discharged to the boiler through a single duct ending in a double-tipped burner.

The elevator conveyor, which has a capacity of 50 tons per hour, is driven by a 10-hp. motor through a clutch.

The shuttle belt conveyor used for distributing coal to the various bunkers is provided with a 20-in., 6-ply belt. This belt with its rolls, idlers, drive, etc., is assembled on a structural steel frame which, in turn, is mounted on light trucks to permit shifting as desired. The conveyor is driven by a 5-hp. reversing motor. Requiring only the partial time of an operator for starting and stopping, the operation of this coal-handling rig is practically automatic.

Each pulverizer is driven by a 30-hp. motor, the complete unit being mounted on a concrete pier for convenience of inspection, coal and air control, etc. This pier is designed with ample mass to meet the foundation requirements of high-speed rotating apparatus.

The pulverizer consists of a cylindrical housing of heavy cast-iron construction containing a rotor carried in ring-oiled babbitted bearings at each end of the housing. It is mounted on a substantial cast-iron sub-base which is extended so as to receive the driving motor. (The same support is used for turbine drive in some installations.) A flexible coupling is provided between the pulverizer and motor.

Coal of a size 1½ in. or smaller is fed onto a rotating-

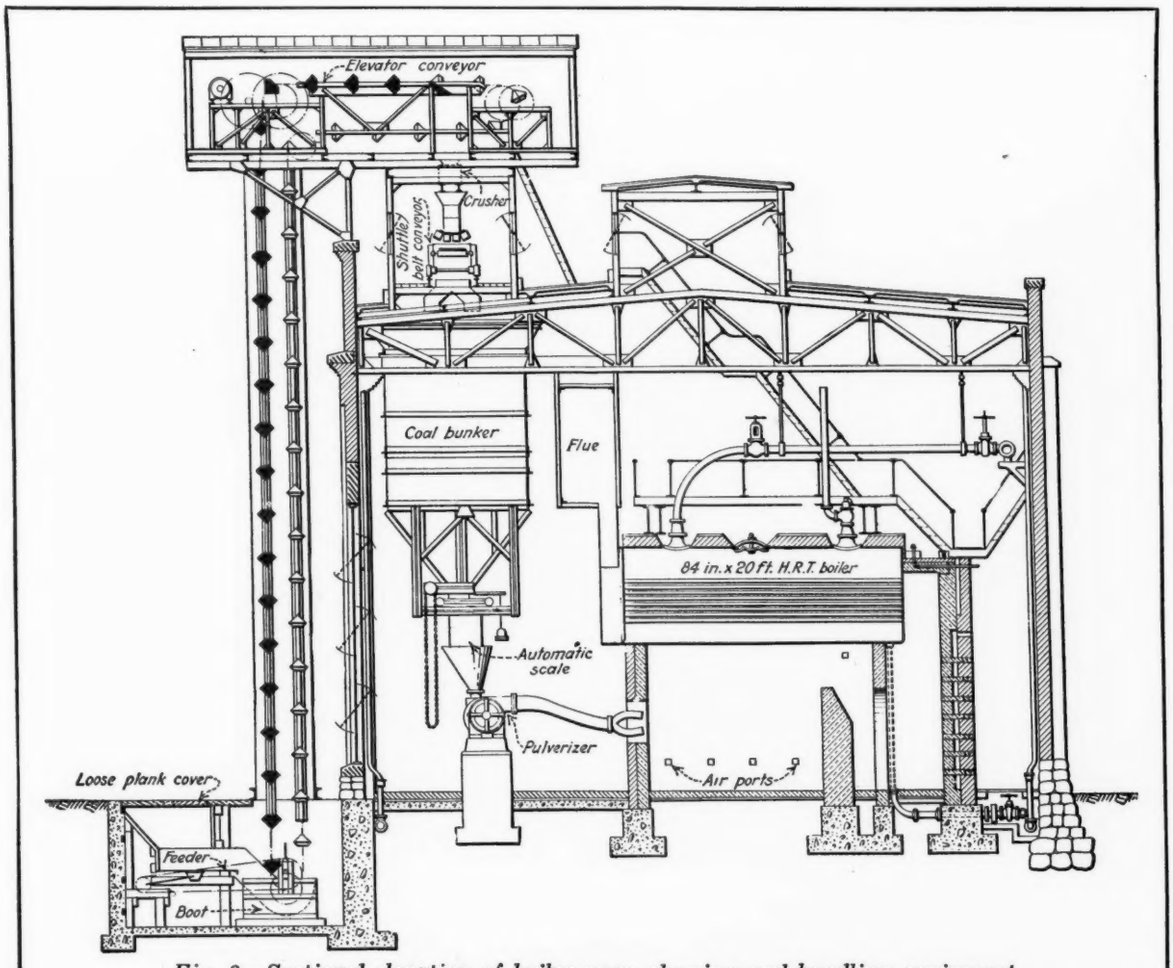



*Fig. 3—Sectional elevation of boiler room showing coal-handling equipment*

Coal, hauled by truck from a coal pocket at the freight yards, is raised to the crusher by a "V"-bucket elevator. The crushed coal is delivered to the bunkers by a shuttle belt conveyor. From the bunkers it passes through an automatic weigher to the pulverizer hoppers. There are three boilers in all, two being equipped with individual unit pulverizers and one (a spare) hand fired. Draft is provided by a 150-ft. brick stack of 6 ft. internal diameter.

feed table in the feed housing at one end of the machine, the amount of coal entering the pulverizer being controlled by regulating the height of a sleeve directly over the rotating table.

The coal is discharged from the feed table into the first or paddle chamber of the pulverizer, where it is struck by paddles mounted on a circular steel disk. This chamber has a steel-plate lining.

A magnetic separator[1] is used in the coal-handling system so that the coal as it reaches the pulverizer is free from stray iron, but occasionally small pieces of iron may get into the pulverizer. To catch these there is a cleanout pocket at the bottom of the paddle chamber.

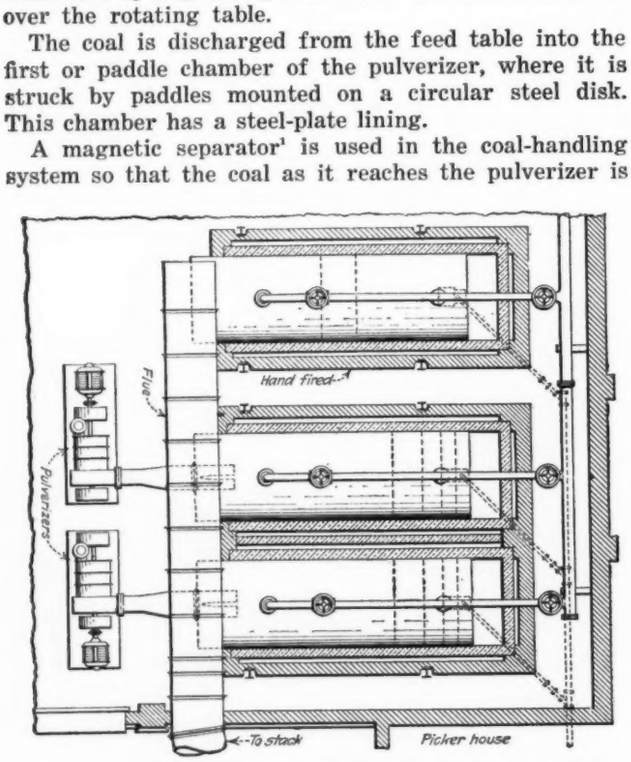



*Fig. 4—Plan showing arrangement of boilers and pulverizers*

Warm air from the air-cooled walls is admitted to the furnace through ports which are shown in Fig. 3.

The coal is reduced to a size ⅛ in. and smaller in this chamber and the finer particles are lifted, by the air sweeping through the pulverizer, into the second chamber, which contains a drum on which blades are mounted which accomplish final pulverization, reducing the coal to suitable fineness for rapid and complete combustion.

The drum is built up of heavy steel plate. Tee bars are riveted in place around its circumference, forming tee slots in which the blades are held. A retaining ring secured against one end of the drum holds the blades in place. A complete set of the blades and paddles can be renewed in from one to two hours.

The drum chamber also has a steel plate liner on which are mounted steel bars or cleats which form obstructions in the path of the coal, tending to throw it continually into the path of the pulverizing blades.

A fan is mounted on the shaft in the chamber directly beyond the drum chamber. The fine particles of coal are drawn into the fan chamber, and as much additional air as it is desired to mix with the coal for combustion is admitted into this fan chamber through adjustable dampers.

Welded steel piping is used between the discharge outlet of the pulverizer and the burners in the furnace, eliminating any chance of leakage of the powdered coal into the room.

Pulverizers of this type operate at constant speeds ranging from 900 to 1,800 r.p.m. for the different sizes. The capacities are based on coal containing up to 5 per cent surface moisture. Coal of considerably higher moisture can be handled at somewhat reduced capacity. Lignite containing 25 per cent to 30 per cent inherent moisture has practically no effect on the capacity of the pulverizer unless considerable surface moisture is also present. Special burners for either vertical or horizontal firing are provided to suit the type of furnace to which the equipment is applied.

As will be noted from Fig. 3, additional combustion air is admitted around the burners and through ports in the air-cooled side walls. While the proportions may be varied at will, the normal percentages of air supplied at various points are about as follows: Primary air from pulverizers, 60 per cent; around burners, 15 per cent; through air ports, 25 per cent. Natural draft is provided by a 150-ft. radial brick stack of 6-ft. internal diameter.

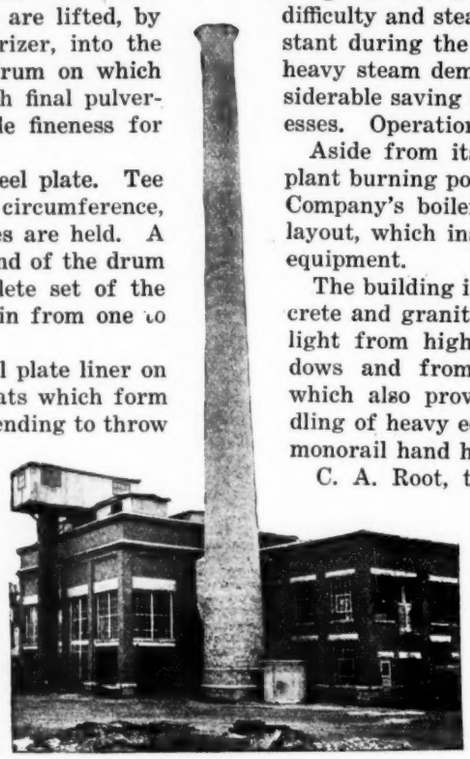
It is claimed that the operation of this plant since completion shows a saving of 40 per cent in coal and more than 50 per cent in labor over the old plant. Test efficiencies have averaged around 80 per cent, five 24-hour tests made last October showing an average combined boiler and furnace efficiency of 79.48 per cent.

Actual operating records, from venturi meter and coal scales during twenty consecutive days run in October, 1924, showed an equivalent evaporation of 10.98 lb. "from and at 212 deg." per pound of coal fired. The coal ran 14,500 B.t.u. per pound, so that the average boiler and furnace efficiency during this period was 73.5 per cent, including cooling down of the boilers at night.

Ratings of 200 to 250 per cent are carried without difficulty and steam pressure is kept practically constant during the periods when the dyehouse makes heavy steam demands. This has resulted in a considerable saving of time in the manufacturing processes. Operation is practically smokeless.

Aside from its comparative novelty as a textile plant burning powdered fuel, the Uxbridge Worsted Company's boiler plant is noteworthy for its neat layout, which insures light, air and accessibility of equipment.

The building is of brick with a foundation of concrete and granite. The boiler room is flooded with light from high metal-frame and wire-glass windows and from a light structural-steel monitor which also provides ample ventilation. The handling of heavy equipment is simplified by the use of monorail hand hoists and large lifting doors.



C. A. Root, treasurer and manager of the Uxbridge Worsted Company, Inc., is largely responsible for the application of pulverized coal at this plant. The pulverizing equipment was furnished by the Erie City Iron Works. Acknowledgment is made to George P. Carver, Inc., of Boston, designers and builders of the plant for data and drawings.

[1] A magnetic separator should invariably be used to insure the removal of scrap iron, mine teeth, track bolts, etc., from which no coal is uniformly free.

# Modification of Orsat Apparatus

By G. A. de Graaf*

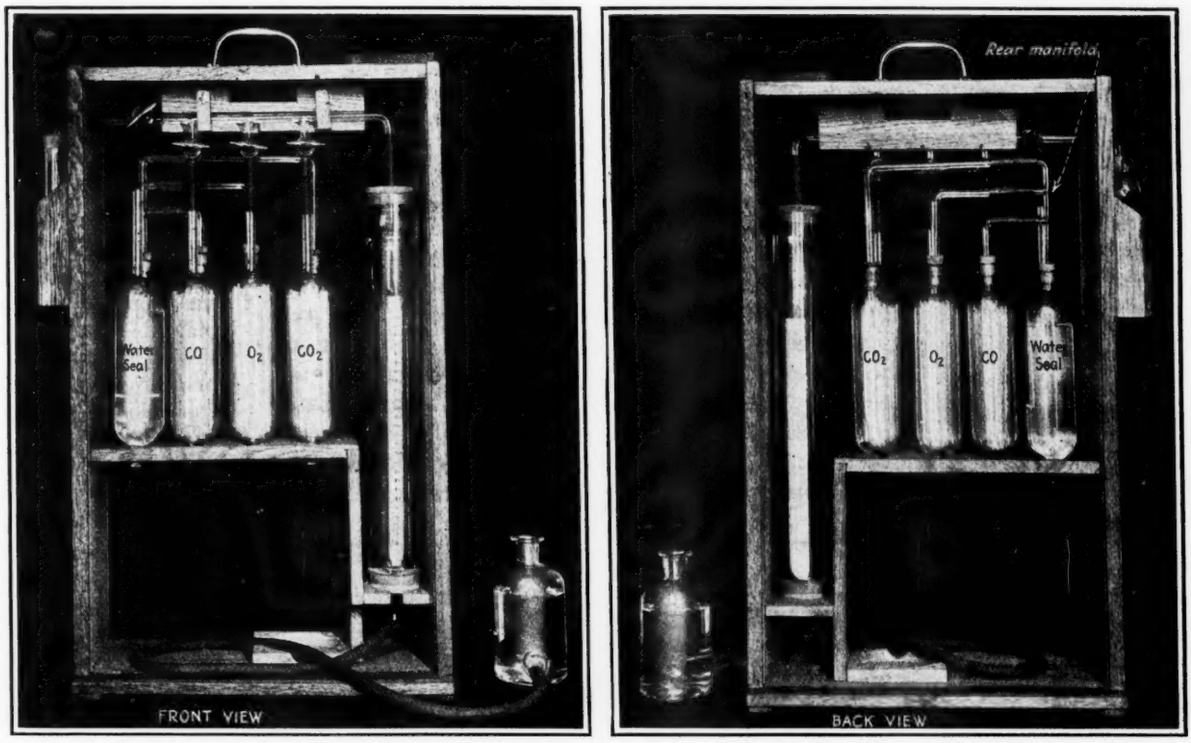
THE Orsat apparatus for the determination of carbon dioxide, oxygen and carbon monoxide consists essentially of a measuring burette with water jacket, a leveling bottle that is connected by means of a long piece of rubber tubing to the bottom of the measuring burette, a manifold with four stopcocks and three absorption pipettes. The measuring burette is connected to one side of the manifold while the absorption pipettes are connected to the manifold by means of the stopcocks. The fourth stopcock (a three-way cock) is used either to admit the sample of gas to the measuring burette or to reject it after analysis is completed.

When the gas sample is transferred from the measuring burette to the absorption pipette, the air that is in the second half of the absorption pipette (not filled with the reagent) must be temporarily displaced and collected in a receptacle from which it can be drawn when the residue of the gas under analysis is removed to the measuring burette to determine the absorption. For this purpose it has been customary to provide each pipette with an individual small rubber bag.

The objection to the use of rubber bags is obvious. Their life is short, they become hard, crack and spring a leak, thus spoiling an analysis. Many reagents have been spoiled owing to leaky rubber bags. To overcome this trouble the apparatus was provided with a fourth pipette. This fourth pipette contains water and is connected by means of glass tubing of 2-mm. bore to each pipette.

When a gas sample is transferred to the absorption pipette by raising the leveling bottle, the solution in the first half of the pipette is brought into the second half where it will displace the air. This air will travel through the glass tubing into the fourth pipette containing the water, forcing this water into the front part of the pipette. When the residual gas sample is brought back into the measuring burette, the action will be reversed.

The ordinary Orsat apparatus provides enough space for the extra pipette. A slot to hold it is easily cut in the wooden shelf supporting the pipettes. There is no change in the mode of operation of the apparatus. The modified apparatus has been in use for several years and has given great satisfaction. The first cost of the extra absorption pipette and the small glass parts about equals the cost of three rubber bags. The difference is that the pipette will last indefinitely, while the rubber bags deteriorate rapidly, become troublesome and costly. Incidentally, the modification gives the apparatus a neater appearance.




*One water-filled double pipette with manifold serves as water seal for back branches of three absorption pipettes*

During the manufacture of condenser tubes it is very necessary to control the stiffness and strength of the material. It is not advisable to leave the tubes in a hard, cold drawn condition, neither is it advisable to leave them in an overannealed or too soft condition. Unannealed tubes that are left hard drawn or too hard, will split lengthwise no matter how perfect they may be physically and in spite of a widely varying choice in the proportions of the metals composing them. This splitting is caused by the releasing, due to corrosion, of circumferential stresses that exist in the tube walls, these stresses being the resultant effect of working the metal cold.

*Chemical Division Chief, Testing Laboratory, Public Service Electric & Gas Co., Irvington, N. J.

# Present Status of the Air Preheater*

By C. W. E. CLARKE
Mechanical Engineer, Dwight P. Robinson & Company, New York City

**FOLLOWING a historical summary of air preheating in metallurgical furnaces and early applications to the steam boiler, the author reviewed the present status of the air preheater in the power plant, showing typical installations of the three main types in use, with tabulated data on installations in operation and in course of erection. The accompanying abstract deals with recent operating developments in air preheating.**

WITHIN the last few years the use of preheaters has been greatly stimulated. At the present time there are a number of flue-gas preheaters on the market, divided into three types—flat plate, tubular and rotative.[1] The heating surface may vary from around one-half to twice that of the boiler.

Experience to date with the plate-type preheater has shown little trouble from fouling. A number of installations have been provided with soot blowers, although there are fully as many with no provision for cleaning except by hand through the access doors. It is probable that with some grades of fuel, soot blowers will be necessary. This type of heater always should be installed with the gas and air passes vertical to facilitate self cleaning. There is some vibration of the plates which tends to dislodge any adhering material. Cinders entrained in the gases should have considerable scouring action and therefore aid in keeping the surface clean. With certain fuels containing large amounts of moisture and sulphur there will be considerable corrosion, but on account of the structure and low-pressure differences in this apparatus the metal may be reduced to paper thickness before replacement should be necessary. Figs. 1 to 3 show typical installations of air preheaters.

Preheating air with steam extracted from the turbine has been advanced as a means for increasing power-plant efficiency. If a proper bleeder system for feed heating is installed which heats the water to the highest temperature permitted by the steam conditions prevailing in a given installation, there is not sufficient heat capacity left in the feed water to warrant the installation of economizers. Under such conditions the only possible method of reclaiming the heat of the flue gas is by an air preheater. Then if full advantage is taken of this means of heat reclamation, there is no heat capacity left for which a steam preheater can be used. It would be possible to use, say, a two- or three-stage bleeder feed heating system and an economizer for further heating of the water. This would remove part of the available heat from the gases, and the remainder could be used for partly heating the combustion air. The rest of the air heating could then be done with steam bled from the turbine.

Such a system has no inherent advantage over any other system that will reclaim all available heat from the flue gases and heat the water to a given maximum temperature. Involving, as it does, bleeder heaters, economizers, steam air heaters and flue-gas air heaters, such an arrangement contains every possible complication and produces no more than the simpler system containing a bleeder system for heating the feed water and flue-gas air preheater for reclaiming the heat from the furnace gases.

To show the relative merits of steam air preheating and preheating with flue gases, the heat rates for two cycles based on net station output and exclusive of boiler-room losses have been calculated as follows:

With steam air heating and economizer, 12,165 B.t.u. per kw.-hr. With four-stage bleeder and flue-gas preheater, 12,085 B.t.u. per kw.-hr.

Experience has shown that the introduction of heated air to the furnace results in a considerable improvement in combustion by bringing the combining zone closer to the fuel bed and probably reducing the furnace volume necessary for the combustion of a given weight of fuel per unit of time. It also should have the effect of causing more complete combustion in the fuel bed itself on account of lessening the necessity for the downward travel of the heat through the fuel. This supposition is borne out by the reduction of combustible found in the ash from furnaces using preheated air as compared with those using cold air.

In pulverized-fuel furnaces the same general considerations hold good. It is the time factor required for heating the fuel and air that is responsible largely for the long flame travel and consequent large furnace volumes required with present burning methods. It has been observed in the furnaces recently installed in the Colfax station, that when preheated air is used, the flame is shortened.

It appears that any tendency to slagging is accentuated with preheated air. The general temperature level in the furnace is, of course, raised and the solidification of the slag therefore retarded. This results in a more freely running slag on the furnace walls and consequently rapid erosion of the brickwork. It is the writer's opinion that unless an entirely new type of refractory is developed, pulverized-fuel furnaces using preheated air cannot be operated successfully at high ratings except with special cooling arrangements for the furnace walls.

Though the draft loss through air preheaters is relatively small, it is sufficient to place a definite limit upon the ratings that can be attained with a given equipment on natural draft. It is of benefit to so install preheaters as to provide an open passage through them closed by a damper which may be opened when

*Abstract of paper read at Power Meeting of the Chicago Section of the American Society of Mechanical Engineers, Jan. 15, 1925.

[1]Detailed descriptions of these types may be found in *Power*, Dec. 2, 1924, p. 884.

extraordinarily high ratings are desired and efficiency for the time being may be sacrificed.

Data collected on preheater installations are given in Tables I and II, the former including only installations in operation at the time this paper was written and Table II installations in course of erection or on order. The figures given in these tables are exactly as they were received, and although some of them seem doubtful, time was not available for checking, part of the data having come from abroad.

## Discussion

R. J. S. Pigott, mechanical engineer, Stevens & Wood, Inc., New York City, stated that if bleed heating is carried higher than 300 deg., with the intent to eliminate the economizer, it will pay, especially if the upper limit bleeding is done from house turbines instead of from the main unit. When the bleeding is carried up to the point that the economizer has no longer an opportunity to add heat to the feed water, the only remaining method of recovering sensible heat in the flue gases is by the air preheater. It is possible to abstract as much heat from the flue gases by the air preheater as with the economizer. By using the air preheater in this manner, the maximum opportunity for raising the turbine-room cyclic efficiency is offered, and in the boiler room the same heat from the flue gases can be recovered, but with additional indeterminate improvement in combustion efficiency.

Ultimately, the volume of powdered-coal furnaces as now installed must be reduced, and preheated air is one of the means by which the necessary volume of furnace can be cut down. The principal advantage of the air preheater over the economizer is that it is not under high pressure, and for the same heat recovery the air preheater is somewhat less expensive to install. With regard to cleaning, less trouble is to be apprehended from the preheater than has been the case with the economizer.

For the present it seems fairly safe to say that the use of preheated air will improve combustion conditions so far as efficiency of the boiler is concerned; will somewhat raise the maximum capacity, and the water-cooled furnaces should provide sufficient protection against the increased tendency to slag.

Henry Kreisinger, of the Combustion Engineering Corp., agreed that air heaters should be more generally used than at present, and as they came into more general use it was his opinion that the upkeep would be smaller than with the economizer. While the flame might be somewhat shorter, owing to the higher air temperatures produced by preheaters, he did not think that a radical change in the length of flame and furnace volume required for nearly complete combustion could be expected by the use of air heaters.

W. E. Caldwell, of the United Electric Light & Power Co., New York City, asked whether the total auxiliary power would not be slightly greater with the preheater than with the economizer. The latter required only an induced-draft fan, and the loss in the heat of the water was practically negligible, whereas in an air-heater installation, in addition to the induced-draft

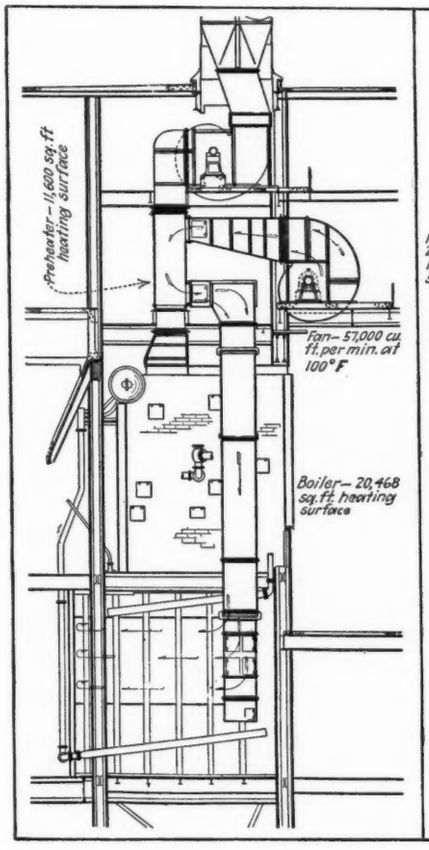



*Fig. 1—Plate-type preheater in plant of Ohio River Edison Co., Toronto, Ohio*

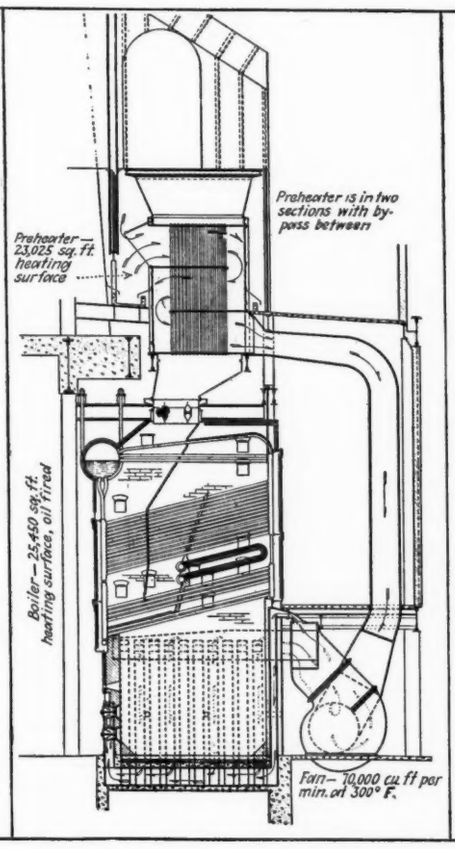

Preheater is in two sections with by-pass between
Preheater—23,025 sq. ft. heating surface
Boiler—25,450 sq. ft. heating surface, oil fired
Fan—70,000 cu ft per min. at 300° F.

*Fig. 2—Tubular preheater installation of Los Angeles Gas and Electric Corp.*

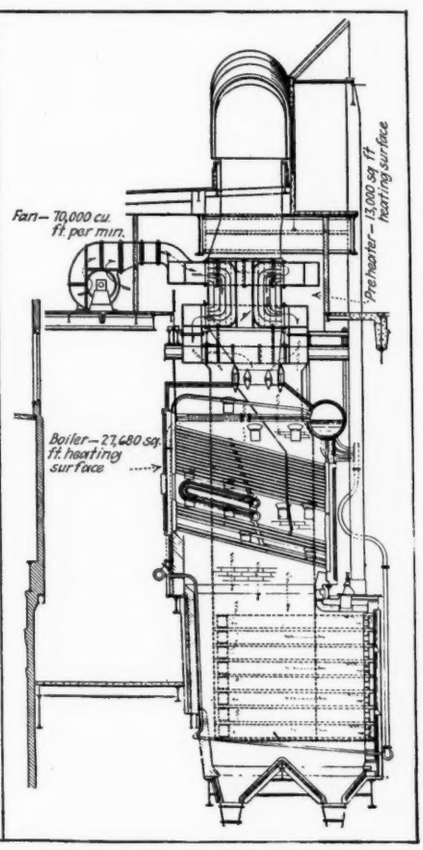



*Fig. 3—Plate-type preheater with pulverized fuel at Colfax Station, Duquesne Light Co.*

TABLE I—PREHEATER INSTALLATIONS

| Company | Boilers | | | | Preheaters | | Temperatures, deg. F. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Entering | | Leaving | |
| | Make | Size Sq.Ft. | Per Cent Rating | No. | Make | Surface Sq.Ft. | Gas | Air | Gas | Air |
| Commonwealth Edison Co., Calumet Station | B. & W. | 15,089 | 235 | 1 | C. E. | 9,000 | 326 | 61 | 263 | 151 |
| Commonwealth Edison Co., Calumet Station | B. & W. | 15,089 | ... | 1 | B. & W. Tubular | 8,773 | 315 | 70 | 262 | 130 |
| Duquesne Light Co., Colfax Station | B. & W. | 22,910 | 200 | 2 | C. E. | 11,200 | 510 | 70 | 350 | 218 |
| Duquesne Light Co., Colfax Station | B. & W. | 22,910 | ... | 1 | C. E. | 13,000 | 510 | 70 | 350 | 218 |
| Duquesne Light Co., Colfax Station | B. & W. | 27,680 | ... | 2 | C. E. | 13,000 | 550 | 70 | 407 | 236 |
| Duquesne Light Co., Colfax Station | B. & W. | 27,680 | 21 | 2 | C. E. | 13,000 | 491 | 86 | 379 | 252 |
| Eagle Paper Co., Joliet, Ill. | Page | 2,300 | *** | 1 | C. E. | 1,508 | 575 | 70 | 411 | 246 |
| Benoist & Co., Riorges, France | Semi-Tub. | 1,960 | 81 | 1 | Thermix | 1,510 | 500 | 62 | *** | 163 |
| The Hague Cent. Elec. Wks., The Hague, Holland | B. & W. | 6,724 | *** | 2 | Thermix | 7,532 | 392 | 79 | 317 | 167 |
| The Hague Cent. Elec. Wks., The Hague, Holland | Mar. | 7,075 | *** | *** | Pratt | 7,530 | 433 | 81 | 342 | 177 |
| The Manchester Corp., Barton Station | B. & W. Mar. | 16,020 | *** | 9 | B. & W. Tubular | 12,080 | 401 | 57 | 295 | 184 |
| Newcastle-on-Tyne Elect. Sup. Co., No. Tees Sta. | B. & W. Mar. | 6,980 | *** | 10 | B. & W. Tubular | 9,245 | 542 | 63 | 306 | 346 |
| North Metropolitan Elec. Supply Co., Willesden | B. & W. | 4,780 | *** | 1 | Howden Ljung'm | 11,900 | 595 | 64 | 269 | 474 |
| Union d'Electricite Gennevilliers | Lille. Stirl. | 22,600 | 244 Approx. | 5 | Humboldt & Ther. | 19,250 | 437 | 104 | 311 | 221 |
| Union d'Electricite Gennevilliers | B. & W. c.d. | 14,850 | *** | 10 | Humboldt & Ther. | 12,050 | 382 | 104 | 275 | 203 |
| Lutterbach Brewery | Semi-Tub. | 2,300 | *** | *** | Thermix | 2,800 | 541 | 117 | 379 | 242 |
| Star Paper Mill, Blackburn | Lanc. | 1,000 | 160 | 1 | Howden Ljung'm | 8,000 | 935 | 83 | 367 | 659 |
| Connery & Co., Inc., Chester, Pa | Stirl. | 14,217 | *** | 1 | Conn.ry Plate | 22,072 | 624 | 80 | 403 | 325 |
| Delaware County Electric Co., Chester, Pa | Stirl. | 14,217 | *** | 4 | B. & W. Tubular | 22,000 | *** | *** | *** | *** |
| Delaware County Electric Co., Chester, Pa | Stirl. | 14,217 | *** | 1 | B. & W. Plate | 22,000 | *** | *** | *** | *** |
| Devenport Dockyard, England | Wood | 4,100 | 218 | 2 | USCO | 2,378 | 691 | 77 | 402 | 230 |
| Portsmouth Dockyard, England | Stirl. | 3,660 | 174 | 5 | USCO | 1,800 | 526 | 68 | 374 | 197 |
| Francis Stevenson & Co., Dundee, Scotland | Lanc. | *** | *** | 2 Tand. | USCO. | 4,524 | 794 | 74 | 450 | 335 |
| Central Electric Supply Co., London, England | B. & W. Mar. | 8,619 | 260 | 4 | USCO. | 9 020 | 382.5 | 99.6 | 279.4 | 211.7 |

TABLE II—PREHEATERS IN PROCESS OF

| Company | Boilers | | | | Preheaters | | Temperatures, deg. F. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Entering | | Leaving | |
| | Make | Size Sq.Ft. | Per Cent Rating | No. | Make | Surface Sq.Ft. | Gas | Air | Gas | Air |
| Adirondack Power & Light Co., Amsterdam | B. & W. | 19,830 | *** | 3 | C. E. | 11,700 | 429 | 80 | 279 | 241 |
| Bosh Food Prod. Co., Peoria, Ill. | B. & W. | 2,140 | *** | 1 | C. E. | 810 | 550 | 70 | 310 | 310 |
| Ohio Power Co., Philo, Ohio | B. & W. | 14,090 | *** | 4 | C. E. | 9,700 | 400 | 60 | 290 | 170 |
| Ohio River Ed. Co., Toronto, Ohio | B. & W. | 20,500 | *** | 4 | C. E. | 11,700 | 612 | 100 | 479 | 280 |
| General Construction Co., Seward, Pa | B. & W. | 18,300 | 200 | 2 | C. E. | 10,520 | 510 | 70 | 367 | 223 |
| Kansas City Power & Light Co., Kansas City | Heine | 12,740 | *** | 1 | C. E. | 9,600 | 540 | 70 | *** | 170 |
| Narragansett Electric Light Co., Eddy St. | B. & W. | 18,750 | *** | 1 | C. E. | 14,100 | 475 | 70 | 294 | 302 |
| Narragansett Electric Light Co., Eddy St. | B. & W. | 18,755 | *** | 1 | B. & W. Tubular | 14,961 | 535 | 80 | 347 | 293 |
| General Electric Co., Phila., Pa. | B. & W. | 5,535 | *** | 1 | B. & W. Plate | 5,735 | 530 | 80 | 369 | 265 |
| Houston Lighting Co., Houston, Tex. | B. & W. | 19,844 | *** | 1 | B. & W. Tubular | 11,660 | 565 | 150 | 450 | 283 |
| Los Angeles Gas & Elec. Corp., Los Angeles | B. & W. | 25,450 | 200 | 3 | B. & W. Tubular | 23,025 | 557 | 70 | 358 | 300 |
| Montaup Electric Co., Fall River, Somerset Sta. | Stirl. | 14,916 | *** | 1 | Horiz. Tubular | 10,514 | 387 | 70 | 295 | 175 |
| New York Edison Co., Waterside, No. 2 | B. & W. | Two 6,500 | 200 | 1 | Thermix | 12,100 | 450 | 70 | 278 | 252 |
| Russell-Miller Milling Co., Grand Forks, N. D. | | Two 2,500 | *** | 1 | Thermix | 2,160 | 410 | 55 | 236 | 140 |
| Phoenix Utility Co., Carolina Pr. Co., Moncure, N. C. | | 11,390 | *** | 2 | C. E. | 6,075 | 680 | 125 | 530 | 283 |
| Delaware County Electric Co., Chester, Pa. | Stirl. | 14,217 | *** | 1 | P. E. Plate | 22,000 | *** | *** | *** | *** |
| Delaware County Electric Co., Chester, Pa. | Stirl. | 14,217 | *** | 1 | Ljung'm | 64,960 | *** | *** | *** | *** |
| Delaware County Electric Co., Chester, Pa. | Stirl. | 14,217 | *** | 1 | B. & W. Tubular | 50,000 | *** | *** | *** | *** |

***Information not available.

fan, a forced-draft fan was required. He also questioned whether leakage would not be a serious matter in the preheated air ducts and the necessary connections.

C. M. Hardin, assuming that Mr. Clarke's figures were correct, agreed that the four-stage feed-water heating with air preheating was more efficient than the economizer and the steam air preheating arrangement. There was no doubt that the capital cost would be less for the basic reason that there was only one low heat transfer as compared to two low heat transfers with the economizer and steam preheating. In other words, there were two gases in one case and one gas in the other, where the unit heat transfer was somewhere around 10 to 20, while with stage heating the unit heat transfer was all the way from 400 up to probably 600.

A. D. Bailey, of the Commonwealth Edison Co., Chicago, said that he had no doubt as to the benefits to be derived from preheated air. With the plate type of air preheater installed by the company, the heating amounted to only about 80 deg. F., as the preheaters had been installed behind the economizers. The gas temperatures entering the preheaters were comparatively low, yet with the small increase in heat, improvement in the operation of the furnace could be seen and it was evident that if the temperature of the air was increased to 300 deg. or higher, a further improvement in furnace conditions would be obtained. With Illinois coal having 4 or 5 per cent of sulphur, it had become evident that maintenance was going to bear an important part in the utilization of air preheaters, as it had with economizers.

Francis Hodgkinson, chief engineer of the Westinghouse Electric & Manufacturing Co., stated that the mechanical difficulties of the air preheater were less than with the economizer, and with the former the air temperatures could be reduced lower than with the water economizer because of the mechanical difficulty of putting the water cold into the economizer.

L. W. Heller, of the Duquesne Light Co., Pittsburgh, agreed with Mr. Bailey in that the quality of coal had a great deal to do with the cleaning of air preheaters. In their plate-type preheaters, after a run of three months there was only a slight sooty deposit resembling blistered paint, which could be removed by a movement of the plates or a light lancing. They were not experiencing any serious dropping off of the heat transfer.

In rebuttal Mr. Clarke did not have data available to show the increase in auxiliary power required by air preheaters. In the first installation at Colfax, the fan that furnished the preheated air also furnished the blast under the stoker. The pressure at the discharge, or the total load on the fan at its suction and discharge sides, was 11 in. of water instead of 7 in. In the preheater first installed at Colfax, there had been con-

NOW IN OPERATION

| Cleaning | | Gain in Efficiency per Cent | Kind of Coal | Heat Value B.t.u. per Lb. | Proximate Analysis, per Cent | | | | | Type Stoker | Type Pulv. Fuel | Type Furnace |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Frequency | Heat Added to Air | | | Vol. | F. Carb. | Ash | Moist | Sulph. | | | |
| Water sprays on gas side | Not Stated | 1.6 | Illinois | 11,800 | 39 | 42.7 | 18.3 | 18. | 4.4 | Coxe | ..... | Solid |
| ..... | ..... | 1.3 | Illinois | 11,800 | 39 | 42.7 | 18.3 | 18. | 4.4 | B. & W. | ..... | Solid |
| None | ..... | ..... | Pitts. Bit. | 13,500 | 34.75 | 53.76 | 8.82 | 2.65 | 1.23 | Underfeed | ..... | Solid |
| None | ..... | ..... | Pitts. Bit. | 13,500 | 34.75 | 53.76 | 18.82 | 2.65 | 1.23 | Underfeed | ..... | Solid |
| None | ..... | ..... | Pitts. Bit. | 13,500 | 34.75 | 53.76 | 8.82 | 2.65 | 1.23 | ..... | Lopuleo | Air Cooled |
| None | ..... | ..... | Pitts. Bit. | 13,300 | 34.75 | 53.76 | 8.82 | 2.65 | 1.23 | ..... | Lopuleo | Air Cooled |
| *** | *** | *** | Illinois | 11,500 | 32. | *** | *** | 8.0 | 2.0 | Type E | ..... | Solid wall |
| *** | *** | *** | Washed Pea | 11,104 | 20.18 | 52.87 | 19.9 | 7.05 | *** | Hand Fired | ..... | *** |
| *** | *** | 2.49 | 50 per cent Scotch | 11,052 | 29.42 | 50.75 | 7.79 | 12.04 | 1.33 | Chain Gr. | ..... | Solid wall |
| *** | *** | 2.70 | 50 per cent York | 11,052 | 29.42 | 50.75 | 7.79 | 12.04 | 1.33 | Chain Gr. | ..... | Solid wall |
| Hand scraper | *** | 3.5 | Lancashire Slack | *** | 28.12 | 46.88 | 13.44 | 11.56 | 1.44 | Chain Gr. | ..... | Solid wall |
| Hand scraper | *** | 7.7 | Small Coal | *** | 30.57 | 48.48 | 17.98 | 2.97 | 1.16 | Chain Gr. | ..... | Solid wall |
| Soot Blowers | 3 to 4 times daily | 10.4 | Gedley Wash Singles | 10,850 | 34.30 | 58.35 | *** | 15.88 | *** | Chain Gr. | ..... | *** |
| Scrapers | Once a week | 2.8 | Bituminous | 12,670 | 17.8 | 75.5 | 9.3 | 5.3 | ..... | Riley | ..... | Solid Wall |
| Scrapers | Once a week | *** | Bituminous | *** | 12.0 | 70.0 | 8.00 | 10.0 | 1.0 | Chain Gr. | ..... | Solid Wall |
| *** | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** |
| Soot Blowers | 6 times daily | 18.0 | Wigan Slack | *** | 27.3 | 50.6 | *** | 6.4 | 2.75 | Hand Fired | ..... | *** |
| Air Lance | Not determined | *** | Bituminous | *** | 22.5 | 65.0 | 10.2 | 2.3 | 1.83 | Underfeed | ..... | Air Cooled |
| *** | *** | *** | *** | *** | 24.45 | 64.25 | 8.29 | 3.01 | 1.18 | Underfeed | ..... | Solid |
| *** | *** | *** | *** | *** | 24.45 | 64.25 | 8.29 | 3.01 | 1.18 | Underfeed | ..... | Solid |
| Steam Lance | *** | *** | Bituminous | 11,300 | 28.66 | *** | 9.9 | 11.5 | *** | Type E | ..... | *** |
| Steam Lance | *** | *** | Hillhouse Pea | 12,487 | 31.4 | 57.6 | 11.0 | 7.47 | *** | USCO "A" | ..... | *** |
| Brushing | *** | *** | *** | 11,910 | 30.27 | *** | *** | *** | *** | USCO"B5" | ..... | ..... |
| Steam Lance | *** | *** | Scotch Pea | 10,980 | 25.82 | 51.13 | 8.43 | 14.62 | *** | USCO"A" | ..... | ..... |

INSTALLATION OR ON ORDER

| Cleaning | | Gain in Efficiency per Cent | Kind of Coal | Heat Value B.t.u. per Lb. | Proximate Analysis, per Cent | | | | | Type Stoker | Type Pulv. Fuel | Type Furnace |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Method | Frequency | Heat Added to Air | | | Vol. | F. Carb. | Ash | Moist | Sulph. | | | |
| *** | *** | *** | Anth. | 11,500 | 5.6 | *** | *** | 10.0 | *** | Coxe | ..... | Solid Wall |
| *** | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** |
| *** | *** | *** | Pitts. Bit. | 11,600 | 36.0 | 43.0 | *** | 4.0 | 5.0 | *** | Coxe | Solid Wall |
| *** | *** | *** | Pitts. No. 8 | *** | *** | *** | *** | *** | *** | *** | Lopuleo | Hol. Wall |
| None | ..... | *** | Penna. Bit. | 13,800 | 18.0 | 71.75 | 10.00 | 0.25 | 2.0 | Underfeed | ..... | Solid Wall |
| *** | *** | *** | Ill. Bit. | 9,770 | *** | 45.08 | *** | 5.0 | 4.12 | Coxe | ..... | Solid Wall |
| *** | *** | *** | W. Va. Bit. | 14,740 | 32.5 | 72.5 | 6.00 | 2.00 | 0.64 | ..... | Yes | W'r Cooled |
| Steam Soot Blowers | ..... | 4.7 | W. Va. Bit. | 14,740 | 21.5 | 72.5 | 6.00 | 2.00 | 0.64 | ..... | Yes | W'r Cooled |
| *** | *** | 3.6 | Oil | *** | *** | *** | *** | *** | *** | ..... | ..... | Solid Wall |
| Hand Brushing | *** | 2.6 | Oil | *** | *** | *** | *** | *** | *** | ..... | ..... | Air Cooled |
| Soot Blowers | ..... | 4.5 | Oil | *** | *** | *** | *** | *** | *** | ..... | ..... | Air Cooled |
| Soot Blowers | ..... | 2.1 | Oil | *** | *** | *** | *** | *** | *** | ..... | ..... | Air Cooled |
| Steam or Air Jets | *** | *** | W. Va. Bit. | *** | *** | *** | *** | *** | *** | Underfeed | ..... | Solid |
| Hand Cleaning | *** | *** | Pocahontas Screenings | 14,000 | *** | *** | *** | *** | *** | McClaveG. | ..... | *** |
| *** | *** | *** | Pocohontas | 13,768 | 15.87 | 71.39 | *** | 2.97 | 0.52 | Underfeed | ..... | *** |
| *** | *** | *** | *** | *** | 24.45 | 64.25 | 8.29 | 3.01 | 1.18 | Underfeed | ..... | Solid |
| *** | *** | *** | *** | *** | 24.45 | 64.25 | 8.29 | 3.01 | 1.18 | Underfeed | ..... | Solid |
| *** | *** | *** | *** | *** | 24.45 | 64.25 | 8.29 | 3.01 | 1.18 | Underfeed | ..... | Solid |

siderable leakage, not in the ducts but in the preheater itself. In this type of preheater welded construction has now been adopted and all ducts as well are welded to avoid the losses incident to leakage.

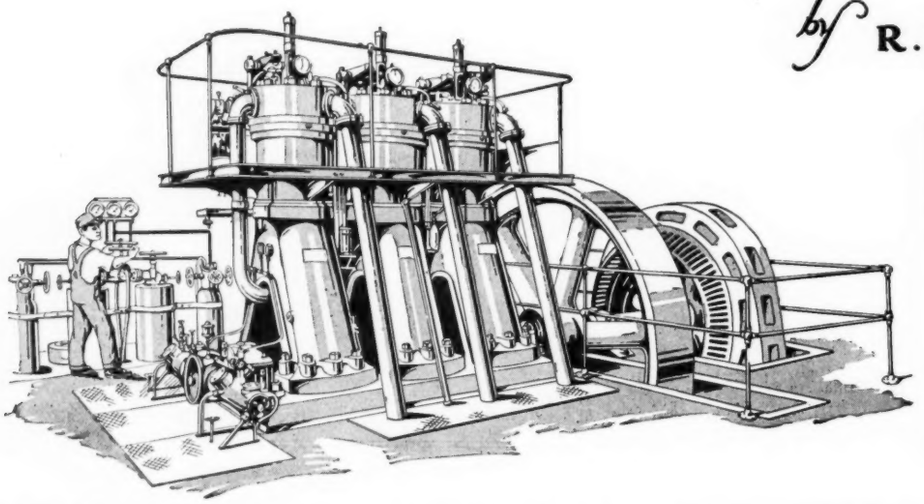
Mr. Clarke believed that some of Mr. Bailey's difficulties relative to the deposits on the preheater surface had been due to carrying the flue gases at too low temperatures. In the preheater it should be possible to corrode to paper thinness as there was little difference in pressure across the plates. The maintenance should be cared for easily, as steel plates are easy to handle. Welding is being done efficiently today, and even with a large amount of erosion he anticipated that the maintenance would be lower than with a pressure economizer.

In connection with a station at Los Angeles, where oil is the principal fuel, some interesting calculations have been made relative to economizers and air preheaters. Combinations or large economizers reducing the flue gas to 250 deg. F. were made and also combinations of two-stage air heaters, as well as combinations of economizers and air heaters to reduce the flue gases to the same temperature. The same conditions were carried through on a flue-gas temperature of about 350 deg. F. Considering investment cost, load factor and oil cost, it was found that the only thing to do from an economic point of view was to install air heaters to heat the air to 300 deg. F. final temperature and lower the flue-gas temperature to the neighborhood of 350 deg. Combination of air heaters and economizers did not have a show owing to the high initial cost.

The following interesting comments on the estimated cost of the Severn (England) tidal scheme were recently made by Major W. Gregson in Manchester, England, and reported in *The Blast Furnace and Steel Plant*. "Taking the Severn barrage scheme as a concrete example in Great Britain and adopting the figures given by Prof. Miles Walker, the approximate estimate for this scheme is £28,000,000 (normally $140,000,000). Deducting $12,500,000 for the railway and road bridge, this brings the estimate for the complete hydro-electric scheme to $127,500,000, excluding transmission lines. Averaged out over a 24-hour day, the output would be approximately 200,000 hp. This means that capitalization would work out at $637.50 per hp. Prof. Miles Walker has demonstrated that it should be possible to reduce the electrical cost in the Severn barrage scheme by $40,000,000, but even at that figure it works out at $437.50 per horsepower." This is considerably higher than most hydro-electric projects.

# OPERATION OF DIESEL ENGINES

by R. Hildebrand *



Notes on Engine Frames and Cylinder Liners

FOR vertical stationary Diesel engines the box frame, Fig. 1, or the A-frame, Fig. 2, is generally used. With the box type the cylinder proper is bolted to the frame, while with the A type the upper part of the engine frame serves as the cylinder.

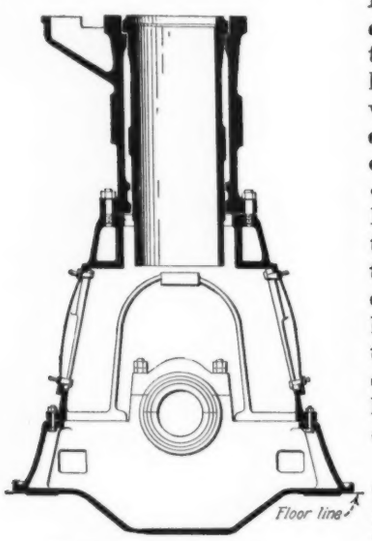



*Fig. 1—Box frame engine*

In the A-frame design it is customary to cool the whole length of the liner, while in a box-frame design the lower part of the liner is generally not cooled. For this reason, in the latter case the temperature in the crankcase may be higher compared with the temperature in engines having the liners cooled over the entire length.

The cylinder liner of a Diesel engine is subject to wear. It may last from two to three years or it may last ten years or longer, depending on the care the engine receives. Even if properly cared for, the liner will not outlast the engine. For this reason the liner in first-class stationary engines is made removable.

The frame and the cylinder proper should last as long as the engine. Improper treatment alone can account for their failure. A frame or a cylinder may crack during the winter should the engine be shut down for a long time. Consequently, the cooling water should be drained off to avoid all danger of freezing.

The liner fits loosely into the upper end of the cylinder or A-frame to allow for radial expansion. The allowance provided for by the designer is based on normal cooling of the engine. However, if excessive scale is allowed to form around the liner, it will heat and expand abnormally, which may cause the cylinder to crack.

*Chief Engineer, Diesel Division, Fulton Iron Works Co.

Unreasonable sledging of the cylinder-head nuts may ruin a cylinder by cracking the seat on which the liner rests at the top of the cylinder. If the gasket between the cylinder head and the liner does not hold tight, the cause of this condition should be eliminated, instead of abusing these parts by overtightening.

Hardly any other element on the engine receives as little consideration from some operators as do gaskets. The object of the gasket is to provide an elastic medium between the seats to take up the minor inaccuracies of the joint surfaces. If these surfaces were ground perfectly true and would remain true, no gasket would be needed. But because of the seasoning of the material and external forces, and particularly because of the heat of combustion, these surfaces warp out of true.

A gasket will counteract the warping of the joining surfaces only to a certain extent. If these surfaces are too much out of true, the gasket alone cannot keep the joint tight. Then there are only two courses: The surfaces must either be ground, and this is the only proper way, or longer wrenches and heavier sledge hammers, generally more convenient for the engineer, must be used to tighten the blowing joints. Heavy sledging does not remove the cause, but only its bad effect, and it is an utterly wrong practice as it causes stresses that overstrain the material and sooner or later develop cracks. Grinding will be necessary only once or twice, for the surfaces of the joints will not warp any further.

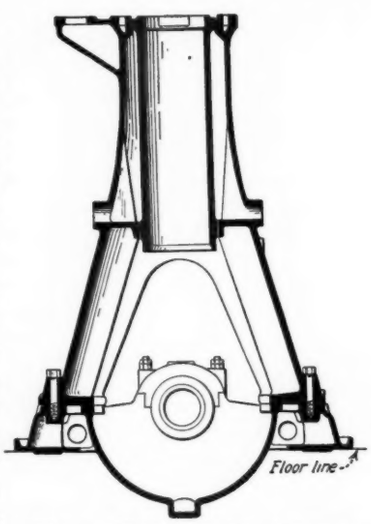



*Fig. 2—Engine with A-frame*

In order to grind conveniently the surfaces forming the seat between the cylinder head and liner, a ring should be used as shown in Fig. 3. The lower end of

the ring fits in the groove of the liner, while its upper end is machined to fit the tongue of the cylinder head. This ring will be used not only for grinding the joint, but also for installing the piston. Thus a grind and guide ring is a very handy power-house tool and is to be recommended.

If the gaskets are closely inspected, in the majority of cases dirt will be found lodged either below or above the gaskets. The utmost care should be exercised to clean not only the surfaces of the joint and the gasket, but also the entire cylinder head before it is brought into place. Certainly, no one should expect a joint to hold tight if dirt lodges between its surfaces. It is an offense in such a case to use long wrenches and a heavy sledge hammer to tighten the joints, instead of taking the necessary precautions to prevent dirt from getting between the seats. The best engine will be ruined if treated in this manner.

The fact that the fractures do not always occur just at the moment the nuts are excessively tightened does not disprove the fact that the fracture was caused by overstraining the material in unreasonably tightening or sledging the nuts. Overstrained material will withstand the forces for a certain length of time before it fails, provided the stresses are below the yielding point.

Adequate lubrication is the principal requirement if good service is to be expected from the cylinder liner. Good lubrication of the liner is impossible unless a suitable lubricant in proper quantity is applied. In addition the liner must be well cooled, and good combustion is essential, as poor combustion tends to destroy the oil film adhering to the liner. The engineer must see that the piston rings are tight, as hot gases blowing past the piston rings not only blow the lubricant adhering to the liner into the crankcase, but tend to dry and vaporize the lubricant. Further requirements are that the piston rings must fit snugly into the grooves of the piston, and the joints or laps of the rings must be as tight as practical.

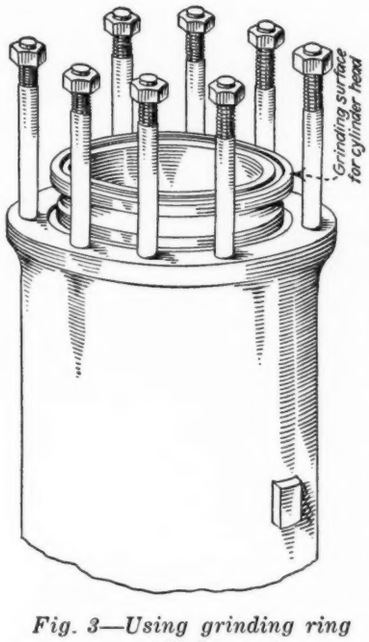



*Fig. 3—Using grinding ring on cylinder seat*

Unless these conditions are met, the liner will not be properly lubricated; it may get dry at its upper end and wear quickly. The engine will then fail to pull its rated load, resulting in a high fuel consumption and a high maintenance cost. It is much easier and cheaper to handle the engine properly than to encounter continuous difficulties.

It is also necessary that dust be kept out of the engine room as far as possible. Keep in mind that a Diesel engine sucks into the cylinder large quantities of air continuously, and that dust contained in the air will in connection with the lubricant adhering to the cylinder liner cause the latter to wear more rapidly than it otherwise would.

A liner should be inspected occasionally to see if it is free from scale. This is done either by removing the liner, or more conveniently, by removing a cleaning cover on the cylinder head. If there is scale deposited in the cylinder head, scale will also adhere to the liner.

In case a liner is to be removed, a mark should be made on the liner and on the cylinder to be certain to place the liner in exactly the same position when reinstalling it. Do not fail to remove the indicator and lubricating connections before the liner is pulled. The most convenient way to pull the liner is with two heavy bolts, about 1½ in. thick, with a yoke on top and bottom as shown in Fig. 4. The yoke may be of hardwood or preferably of two flat irons about 3x¾ in. riveted together with spacers between. The bolts should be long enough so that their nuts are about flush with the top of the cylinder-head studs, which will not then be in the way when the tie bolts are to be tightened.

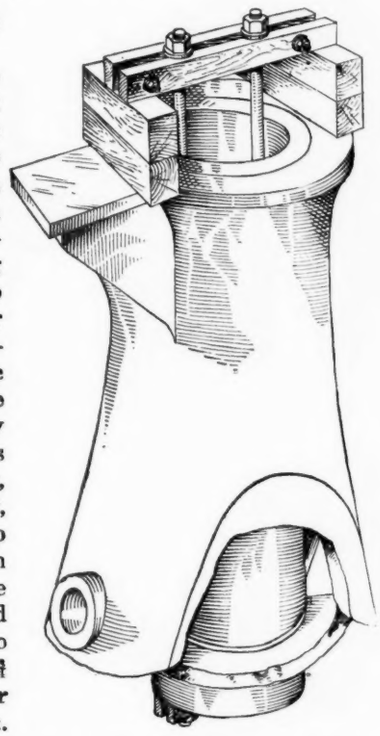


*Fig. 4—Method of removing liner*

If the liner is scored but not excessively, it may be smoothed over with a piece of carborundum. To do this work, the liner should be removed. If the scoring is only slight, the work may be done without removing the liner. In the latter case the crank and the main bearings below the liner should be covered with a canvas to prevent carborundum dust from entering the bearings. However, if the scoring extends over nearly the whole travel of the piston rings and is of such depth that the piston cannot hold tight, then a new liner should be installed. A new liner is also necessary if the old one is worn excessively.

If a piston ring is placed in the lower end of the liner and its joint opens up about $\frac{3}{16}$ to $\frac{1}{4}$ in. when the ring is moved to the upper end, it proves that the liner is too large at its upper end and should be discarded. A discarded liner is not necessarily to be scrapped, but it may be rebored and an oversize piston may be fitted to the liner provided the old piston is defective or nearly ready to be replaced. However, sometimes it is better to have the old piston reground, which takes off only a few thousandths of an inch (for the wear on the piston is always very slight), and to have a new liner made to fit the old reground piston. On a reground piston standard piston rings can generally be used after filing sufficient clearance in the ring joints.

[This is the sixth of a series. Others appeared Jan. 20, Feb. 3, Feb. 17, March 3 and March 17.—Editor.]

*Italy's hydro-electric plants combine the artistic with engineering, as this picture of the Conte Electric Company's plant would indicate*

# Water-Power Development in Italy

By A. R. DECKER

ITALY has developed its hydro-electric resources more rapidly in proportion to its population than any other country in the world. Lack of native fuel is the cause. Italy has practically no fuel, the lignite deposits are small and of poor quality, there is little if any oil and comparatively little wood, although much more than the bare landscape would indicate. During the war, when coal demands were abnormal some Italian railways were obliged to burn wood in their locomotives. Italy imports all its coal, mostly from England and Wales.

This purchasing of fuel affects the entire Italian financial, industrial and political situation. Exclusive of coal imports Italian imports and exports normally tend toward a balance. As it is, coal imports mean an unfavorable trade balance and contribute to the unfavorable financial situation. Hence, for political and economic independence Italy has been faced with the necessity of developing hydro-electric resources in order to provide cheap power within its frontiers.

In case of war Italy has been dependent upon the outside world for fuel for its munition plants and during the world war was menaced with a fuel famine.

Hasty governmental decrees under pressure of war needs marked the attitude of the government toward the early hydro-electric undertakings. Prefects were authorized to grant permits to supply energy for munition plants, traction, power and other war industries. The coal shortage caused the demand for permits to increase rapidly. New methods allowing the use of electricity were adopted, as electric furnaces in metallurgical works, and electric-steam boilers for paper and pulp plants. At first the state exercised no control, leaving all authority in the hands of the local authorities.

Submarine warfare brought about a new situation. In adapting itself to war conditions, perhaps the state went too far in its control. Politics entered into the question of concession; intermediaries, in certain cases, bought up the concessions without assuring development of the water power. It was necessary to obtain a complicated series of permits. All departments gave permits, and it was necessary to obtain permits from each department, which made it almost impossible or required a long time to obtain the right to develop a water power. Capital was frightened away because state ownership was feared, or at least too rigid regulation of rates. The municipal attitude was likewise uncertain, and decrees concerning operation were sometimes considered menacing. Just now there is an effort to place the development of hydro-electric resources on a business basis, and attract capital. The present government is taking an active interest in stimulating hydro-electric construction.

In granting concessions, the principle adopted by the state is that water is for the common good and cannot be monopolized. Also in granting concessions special attention is given to maintaining the purity of the water for local use. Water power is a national wealth and so inseparable in its problems, in Italy, from such matters as artesian wells, regulation of stream flow, prevention of malaria and irrigation, that the state

thinks it necessary to maintain a strict control. There seems to be a tendency to leave a certain amount of liberty for individual initiative, but the state does not intend to disinterest itself entirely.

Public interest and not priority of demand governs the granting of concessions. Due attention is given to the possibility of the concessionnaire developing the project to the extreme limit. To prevent destructive competition, no overlapping concessions are granted, and the principal aim is to substitute water power for coal where possible. Concessions are for fifty, sixty or seventy years, acording to circumstances. Some authorities say that all plants will eventually pass to the state, but at present there does not seem to be any ground for this belief.

### A Complete Hydro-Electric System

Nature endowed Italy with the possibilities of constructing a complete hydro-electric system. In the north the barrier of the Alps crosses the country and forms a storage place for ice and snow, and the Apennines Mountains, forming the backbone of Italy, running toward the south, contain innumerable watercourses waiting to be harnessed. Italian engineers have conceived a plan for distributing hydro-electric energy throughout the entire country. They suggest one great system joining all the power stations at the highest possible voltage. Thus during the winter, while snow and ice accumulated on the Alps, the watercourses of the south would supply energy for the industry of the north. In summer, when the districts of southern Italy are arid, the Alps in turn would supply energy for the center and south. Perhaps with the development of transmission this stupendous scheme will become a fact.

Rainfall is vital to consistent hydro-electric use. During the last two years rainfall has been deficient, about 30 per cent below normal, hence plants already constructed could not operate at capacity. This caused the hydro-electric boosters to urge more reservoirs, while the opponents wanted to return to coal.

Sardinia, an island off the western coast, has only about 5 in. of rainfall, while at the other extreme about 100 in. are recorded annually in the Lombardy region of northern Italy. Precipitation varies according to altitude, climate and exposure. The central and southern Apennines are copiously watered by the humid Tyrrhenian winds. In the northern Apennines the rainfall is greatest in spring and fall. Thence the rainfall grades to southern Italy and to Sicily, where the precipitation is greatest in winter and lightest in summer.

### River Regulation

It is considered that regulation of watercourses will be valuable for reasons other than the production of electric energy. For instance, in Sardinia the land is not suited to agriculture because of the lack of water regulation. For many months the beds of the streams are dry, then come heavy rains which swell the streams to destructive size. Then the Campidoni is flooded, bringing diseases, above all, malaria, which was once the curse of Italy. During many months there is no drinking water and it must be brought by ships from Naples.

Ten years ago there were hardly any water-storage reservoirs in Italy. The first construction was primitive and did not allow for the expansion into modern developments. In this way it came about that larger dams forming bigger reservoirs caused the old ones to be flooded, thus marking Italian hydro-electric development. By 1920 there were 59 reservoirs in Italy, with a capacity of over 8 billion cubic feet of water, and 17 reservoirs in course of construction with a capacity of over 28 billion cubic feet. It is expected that soon over 35 billion cubic feet of water will be stored for low-water period.

Interesting among these reservoirs is Lake Gabiet, with a capacity of 100 million cubic feet. This water is used under two heads; the first, 2,400 ft. and the other 1,750 ft. This power will be used in Turin and Milan.

Some of the reservoirs are very large. One is now being constructed in Sardinia, Lake Amedeo, which will collect the waters from the Tirso basin. This reservoir, or series of reservoirs, will form seven artificial lakes, connected by canals and tunnels, draining the water from the entire island, having an area 1,370 square miles. The total capacity will be about 16 billion cubic feet. It is estimated that four years will be required to finish the work.

It is expected that 600,000,000 kw.-hr. will be produced annually from the storage reservoirs planned for Sardinia. About 75,000 acres will be irrigated and about 25,000 acres of land reclaimed. This project is expected to make Sardinia one of the richest areas in Italian possession. The Banca Commercials, which before the war was controlled by German capital, is said to be financing the project.

### Hydro-Electric Possibilities

An Italian commercial bank, interested in hydro-electric financing, claims that Italy has proportionately more hydro-electric possibilities than any other country in the world. It is estimated that plants capable of producing 3,000,000 hp. exist or are under construction. The Ministry of Agriculture estimates that Italy is capable of developing 5,000,000 hp. The companies interested in hydro-electric installation consider this estimate is low, and the optimistic among them say that with the construction of more reservoirs, 8,000,000 hp. could be developed. They claim the Po basin combined with northern Italy could furnish 3,000,000 hp., and that another 5,000,000 hp. could be developed in other parts of the country. For the Po basin this would mean about 110 hp. per square mile. The building program calls for 2,400,000 hp. to be installed before 1928, or double the 1913 installation.

In 1922 413,775,586 kw.-hr. were consumed for light, twice the amount in 1918. During 1922 3,867,739,699 kw.-hr. were used for power, an increase of 10 per cent over 1918. According to the Ministry of Public Works, Italy in 1915 had 329 power stations of over 300-hp. capacity, with a total of 933,000 hp. By 1920 the number of power stations increased to 383 with a capacity of 1,152,120 hp. Fifty-four plants were then being built with a total capacity of 359,210 hp. This would bring the total installed capacity up to about one and one-half million horsepower. Power stations with a capacity less than 300-hp. were producing about 300,000 hp. These figures would show that the power doubled in five years. As the Ministry of Public Works made its estimates at great detail, these figures may be considered conservative.

The Lake Moncensio plant is one of the most striking of Italian hydro-electric plants. The lake is made by two concrete dams and one dirt embankment, impounding more than one billion cubic feet of water.

This water is used at two sites. There is a head of about 600 ft. on the first station, and a head of about 3,200 ft. on the second station. The latter is the highest-head plant in Italy. The Venaus central station which harnesses this fall is about 1,800 ft. above sea level. There are three 26,000-hp. Pelton-type wheels operating at 500 r.p.m. and connected to 6,600-volt alternators rated at 21,200 kilovolt-amperes. These are the largest capacity units in Italy. There is a transformer for each unit rated at 24,000 kilovolt-amperes, stepping up from 6,600 volts to 75,000 volts. The energy from this plant is distributed at Turin.

Just now a tremendous struggle is being waged all over Europe for domination in the electric field. Different interests are bidding for control in various companies. Rome, Berlin, Paris, Vienna and London exchanges are experiencing a boom in electric securities. Many Italians claim that the struggle between the rivals is impeding development in Italy. A few weeks ago a tentative agreement seems to have been reached when certain concessions were granted to a mixed company. Italian governmental authorities are anxious lest electric-power development should become controlled by interests outside of Italy.

### Power Development and Railroad Electrification

Hydro-electric development in Italy is closely connected with the railroads. Some authorities estimated about 4,000 miles of railroad could be advantageously electrified at a cost of about 1,274,000,000 lire, or about $254,000,000 at par. The original plan has been greatly reduced, perhaps temporarily. Approval has been given for the electrification of the lines Rome-Nettuno and Rome-Tivoli railways. The Pinerola-Torre Pellice and Turin-Modane railways have been, and the Usmate-Bergamo line is being, electrified. Electrification of the Genoa-Spazia and Firenza-Bologna railways is being held up because of delay in obtaining material for power-plant construction, transmission lines and electric locomotives. One of the causes of the delay was the low rainfall, 30 per cent below normal, during the last few years. Some hope to have all electrification completed by 1928 provided funds are obtainable. Electrification requires a great outlay of capital, and probably for this reason as much as any other this work has been held in abeyance during the last few years. One of the last lines to be electrified was the 175-mile stretch between Modane and Genoa.

The railroad administration has a representative on the government hydro-electric board. Certain water powers are reserved for railroad use although this energy has not yet been developed. In the construction of rail lines and hydro-electric plants, consideration is given to both. Dams and aqueducts are sometimes used as railroad bridges, or even highway bridges.

Hydro-electric installations have made possible the traction systems in many towns, and many small industries owe their existence to cheap power furnished by the "white coal." It is even planned to use electric power for plowing and operating other farm machinery.

Directly after the war coal cost about $50 a ton in Italy. It now costs about $10, and a kilowatt-hour of electric energy costs from 50 to 70 centesimi, or from about 10 to 14 cents, on a par basis of exchange.

## Boiler Firing With Natural Gas

By Roland Tullis

Firing boilers with natural or artificial gas is somewhat of a tricky undertaking, especially when the fireman is negligent or inexperienced in handling this type of fuel. Between oil and gas firing, the chief difference is that gas is a more explosive mixture, even when the furnace is cold. Lately, a number of serious and near serious accidents have occurred throughout the country due to inexperienced or negligent handling of gas as fuel. However, it is one of the safest and easiest of fuels to handle when the few simple safety rules are learned and impressed upon the fireman's mind.

For a number of years I have been employed as chief engineer of a plant that contains a number of gas-fired

Fig. 1

*Fig. 1—Torch for igniting burner*

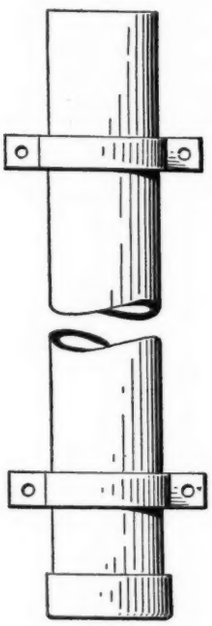


Fig. 2

*Fig. 2—Torch holder*

boilers. We have had little trouble when the firemen are experienced and properly instructed as to the right method of firing gas, but experience and observation have taught us a few pointers that must not be neglected.

When lighting a gas burner, hold the lighting torch very near the tip of the burner, so that the gas will be ignited immediately on leaving the burner.

Do not permit the combustion space to fill with unburned gas. This is dangerous, for if the brickwork is red hot, the gas will ignite suddenly and a dangerous explosion may result.

The gas supply valve to the burner should be opened slowly and the fire gradually increased. The air register should be opened slowly and adjusted until the flame has the proper color. The color will depend somewhat upon the quality of the gas; a clear bluish yellow flame usually indicates a proper mixture of air and gas, while a red, smoky flame indicates insufficient air mixture.

Do not put the air register in the wide-open position when lighting the burner, for the air draft through the burner may blow out the flame. Allowing the flame to burn back inside the burner will destroy the burner.

When this happens the gas must be shut off, the air register adjusted and the burner relighted. After turning on the gas on the burner, never wait a few seconds before lighting it with the torch.

If the gas fires go out, or are extinguished from any cause, shut off the gas supply at the burners and wait a few minutes for the accumulated gas to clear out of the combustion space before relighting the fire.

Watch the gas burners under a cool boiler; they are likely to go out suddenly without apparent cause. The combustion space will fill with explosive gas, and this gas is quite likely to find a tiny live spark somewhere in the combustion space, breeching or stack.

In Fig. 1 is shown a handy lighting torch for gas burners. It is constructed of a piece of rod or small pipe of the desired length, and on one end two large iron washers are clamped with nuts, forming a spool. The spool is wrapped with cotton string, wicking or waste held on with a few turns of iron wire.

A combined torch holder and flame extinguisher is shown in Fig. 2. It is made of 2- or 3-in. pipe closed at the lower end by a cap. It should be attached upright somewhere convenient to the furnaces and kept about half full of kerosene. Keep the lighting torch in this holder. When it is desired to light a burner, remove the lighter, touch it with a match or apply it to another lighted burner. To extinguish the lighter, simply place it back in the holder.

## Latest Development in Steam-Plant Installation in Germany

The return of Germany to a firm currency system and the freeing of the coal beds in the Ruhr district for German consumption have brought about a rebirth of industrial activity in that country. That a gradual return to normal conditions is steadily under way is to be seen from the recently published annual report of the Society of German Engineers on the development of steam-plant installation problems.

During the period of coal shortage only those plants that could cut down their coal consumption were able to operate at all. The question of stoking on a truly economic basis could not be taken into consideration. Today, however, engineers are applying themselves to the problem of obtaining power at the smallest possible expense.

Perhaps the first noticeable advance in this direction is to be found in the fact that the advantage of using different kinds of coal for different purposes is assuming a general industro-economic importance. For example, soft coal is being used more and more on mechanically operated grates. Where coal that has a high ash residue is used, the underfeed and the feed-screw furnace have been introduced, besides the swing, the step and the caterpillar grate. The larger the number of boiler units the more mechanical have become the processes for delivering and feeding coal to the boilers, and of removing the ash.

Bituminous briquets are gradually being supplanted in industrial use by anthracite, which is once more available. Pulverized coal has found increasing favor, and it is being used in an ever larger number of plants.

Besides the changes in the coal situation the past year has witnessed an increased interest and activity in the field of boiler construction. The problems in this field have been greatly influenced by the renewed interest in high pressures. It seemed that boiler constructors would have to reckon with the fact that steam pressures would be greatly increased, and from latest reports, there has been an increase to perhaps 30 or 40 atmospheres. A few installations, in which it is hoped to use higher pressures permanently, will try them for the time being merely for experimental purposes rather than for industrial needs.

### Pressures Over 600 Lb. Not Desirable

The fundamental technical problems concerning the use of even the highest steam pressures have been solved. But industro-economic calculations have shown that with the present type of boiler construction, and in power plants with condensers, a pressure of more than 600 lb. is scarcely advantageous.

High boilers with drums of small diameter and small sectional water-tube boilers have given favorable service. The report doubts whether revolving boilers, such as the "Atmos," will ever be used in large numbers. The extremely high pressures for which these boilers are built demand the use of expensive materials as well as the utmost care in supervising their construction.

Analysis of steam-plant installations shows that there has been no change in the competitive struggle between the piston engine and the turbine. The condensing turbine has made much headway, owing to an improvement in the Bruenner type of construction as well as to betterments in other types. As a matter of fact, the piston engine is being relegated ever more to small productive purposes. On the other hand, the increase in the use of high steam pressures and the increasing importance of back-pressure machines argues for better prospects in store for the piston engine. For it is well known that in the realm of high-pressure performance its percentage of effective operation can scarcely be approached by the turbine.

The questions of intermediate superheating and regenerative heating of the feed water are problems that have been more extensively discussed than put into practice. Despite undisputed theoretical advantages, there is the disadvantage that the installation is bound to be very complicated. If the feed-water heating is done by tapping the steam supply, then the flue gases must be used for the preheating of the combustion air.

### Steam Storage Gaining Favor

An important future field in thermal economy seems to be that of steam storage. Although several Ruth steam accumulators, or reservoirs, have been put into operation, owing to the few published results of experiments in this field, one must reserve final judgment upon them. It is certain that plants needing a continually changing quantity of steam heat for their manufacturing processes would derive considerable benefit from an accumulator. Whether the operating efficiency of the boiler would thereby be favorably influenced has not been definitely proved.

Engineers are paying closer attention to the losses that occur in steam-heating conduits. As a result of numerous tests as to the most suitable rate of steam flow, it has been discovered that stop valves of small resistance render satisfactory service.

In the building of condensers efforts are being directed toward improving the gradually warming process so as to have smaller cooling surfaces. By means of water injectors and water-and-air injectors, attempts are being made to improve the vacuum and to achieve greater safety in operation.

# Elevator Micro-Leveling Equipment

By F. A. ANNETT*

**Construction and operation of equipment for automatically maintaining the elevator-car floor level with the landings.**

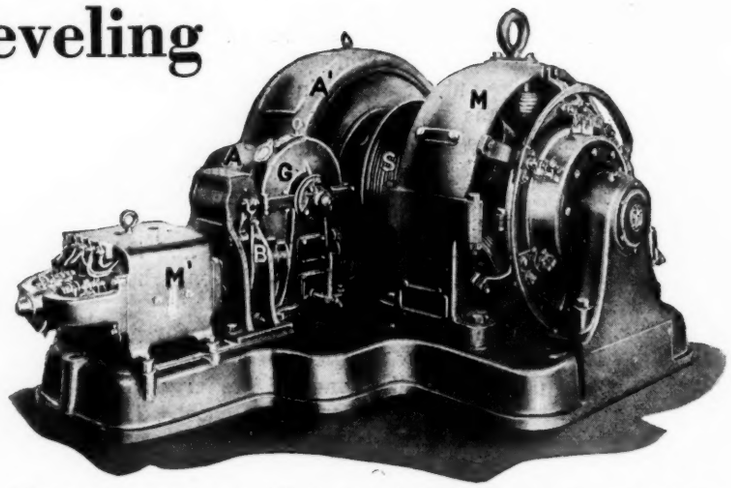



*Fig. 1—Micro drive applied to a direct-traction elevator machine*

ACCURACY of landing and the maintenance of the car-platform level with the landing floor during loading and unloading are two important factors in elevator service. In passenger-elevator service, as the speed of elevator machine is increased the difficulty of accurate landings becomes more difficult. With the usual types of control greater dependence must be placed on the operator's skill to make the landing without undue slowing down of the service, either by slowing down the car too early before stopping, or on account of the operator's failing to make the landing accurately, having to inch the car either up or down.

Accurate landing is also a factor in eliminating hazards due to passengers' tripping. When the car is stopped level with the floor, passengers will move on and off the car in less time than when they must step up or down at the bidding of the operator. Therefore accurate leveling of the car's platform with the landing floors will tend to improve the elevator service as well as decrease the time required to make a round trip. This is particularly true where landing-door interlocks are used and the car must be stopped nearly level with the floor before the door can be opened.

If accurate landings can be assured, not only is it possible to render better and more service with a given number of elevators, but when elevator service is being considered for a new building, it may be possible to reduce the number of elevators installed. This would result in a reduction in the cost of the elevator installation and increase the renting space in the building, which is an even larger factor.

**Power* editorial staff.

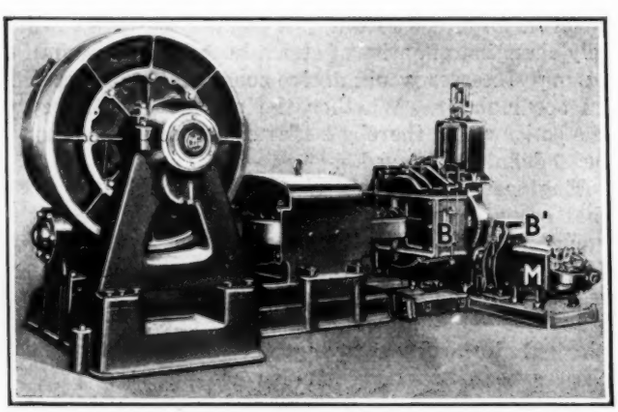



*Fig. 2—Micro drive on a geared-traction machine*

In freight-elevator service stopping of the car level with the landing floors and maintaining this level greatly facilitates the movement of freight on and off the car. It also reduces the wear on freight-handling equipment such as trucks, as well as the damage to merchandise when being loaded on and off the elevator. Maintaining the car level with the landing floor will result in greater safety to employees handling the freight. One of the difficulties in keeping a freight elevator level with the floor is to take care of the stretch in the cables with a change in the load.

When heavily loaded trucks are being put on the car, if the latter's platform is maintained level with the landing floor, the elevator equipment will be relieved of the severe strains of the load dropping two or three inches or a greater distance on the car floor. Preventing these heavy shocks to the equipment will assist materially in reducing the wear, which will not only keep down maintenance costs, but result in better service from elevator equipment.

To start and accelerate the elevator consumes a considerable percentage of the power required to operate the machine. If accurate landings can be made without inching the machine, the power consumption will be kept at a minimum. The power that can be saved by eliminating inching of the elevator will vary with the type of control, being a minimum with an adjustable voltage control and a maximum with rheostatic control. Prevention of inching also reduces the wear on the controller and other parts of the equipment.

A number of developments in elevator design have been made with the object in view of making the leveling of the car to a large degree automatic or independent of the operator. One of these developments is what is known as the micro-drive machine, built by the Otis Elevator Co. A number of different forms of this machine have been brought out, but that shown in the headpiece is one of the latest.

So far as the main motor *M* and traction sheave *S* are concerned, they are the same as for the standard direct-traction machine. In addition to the main ma-

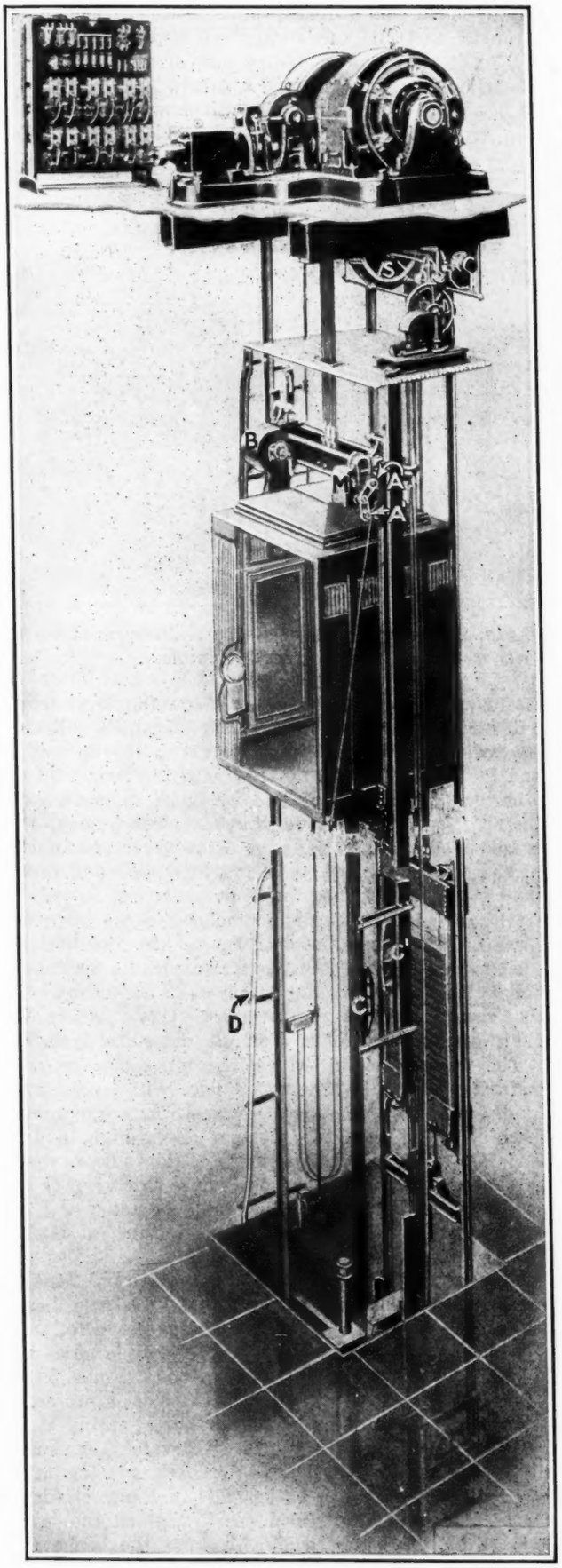



*Fig. 3—Complete installation of direct-traction machine with micro drive*

chine a second, known as the micro-machine, consisting of a motor *M'*, brake *B* and worm gear *G*, is attached to the main machine through suitable gearing. In the figure a small spur gear at *A*, is mounted on an extension of the micro-machine's worm-gear shaft and meshes into a large gear in the case *A'*. The brake shoes are supported on the inside of this gear wheel, and the brake wheel is keyed to the traction-sheave shaft. The brake wheel and brake are so arranged that when the brake is released the main machine is free to move as in the usual design. When the brake is applied, the micro-machine is connected to the main machine. In other words, the brake and brake wheel on the main machine act as a clutch between this machine and the micro.

The micro machine is of small capacity and is only capable of operating the car at a slow speed such as is suited for making accurate landings. For medium-speed machines the micro-machine gives a car speed of 30 to 60 ft. per min., where on high-speed installations the micro-machine gives a car speed of 45 to 90

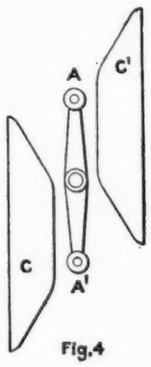



Fig.4

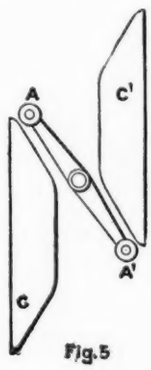



Fig.5

*Fig. 4—Position of micro switch arm "A" when car is in normal operation*

*Fig. 5—Position of micro switch arm "A" when car is stoped level with landing*

ft. per min. However, this does not have a slow-down effect on the elevator's operation since the micro zone does not come into effect until the car is within about 10 in. above or below the floor, for car speeds up to 400 ft. per min. For car speeds of over 400 ft. per min. the micro zone is reached when the car comes within 16 to 18 in. of the floor.

With the micro-leveling machine there are two controllers, one to operate the main machine from the car switch, as in the usual type of medium- and high-speed traction elevator machines. The other controller is for the micro-machine and is brought into operation automatically as the car approaches the floor at which a stop is to be made by a switch mounted on top of the car and cams in the hatchway. This switch has two sets of contacts, one for up motion and the other for down. There are two sets of cams at each landing, one that operates the micro-machine and brings the car up level with the floor and the other for bringing the car down level with the floor.

Fig. 3 shows a complete installation of a micro-drive traction machine. A comparison of this figure with Figs. 3 and 4 in the article on "Traction-Type Machines," Jan. 13 issue of this year, will show that with the exception of the micro-machine being added to the main machine, there is very little difference between this equipment and the standard traction installation.

In Fig. 3 a full-wrap roping is used; that is, the cables pass from the car crosshead over the traction sheave around the secondary sheave *S* and back over the

traction sheave and to the counterweights. The micro-drive can be applied equally well to the half-wrap machine, where the cables pass directly from the car over the traction sheave to the counterweights. It can also be applied to traction machines with two-to-one roping or to the geared type of machine, Fig. 2, or to any application that requires that the elevator car floor be maintained accurately level with the landing floor. In Fig. 2, *B* is the brake on the main machine and acts as a clutch between the main machine and the micro; the latter's motor is shown at *M'* and the brake at *B'*.

### Two Kinds of Installations

There are two kinds of installations, one where it is required that the car make accurate landings at the top and bottom floors, such as on hoists, and the other where intermediate stops are made, as is the case in regular passenger- or freight-elevator service. In the latter a magnet at *M* is mounted on top of the car, Fig. 3, to prevent the micro control from being brought into service as long as the car switch is held in the on position. This magnet holds the arms *A* and *A'* on the leveling switch from engaging cams *C* and *C'* in the hatchway. With the car in the down motion, on approaching the bottom landing an arm on switch *B*, on top of the car, is engaged by cam *D*, which operates the switch and slows the car down. When within about 12 or 16 in. of the landing the main machine is cut out automatically and arm *A'* on the leveling switch engages cam *C'* and cuts the micro-machine into operation, which brings the car down level with the floor. Should the car for any reason go below the floor, cam *C* would operate the leveling machine and bring the

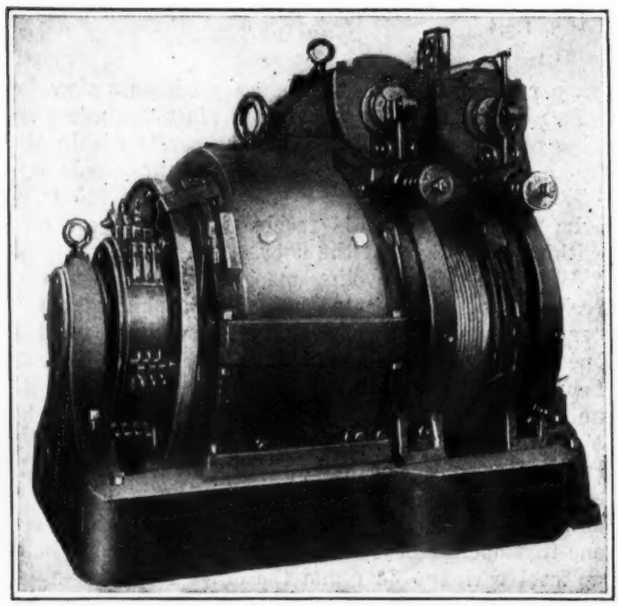


*Fig. 6—Heavy-duty traction machine with two brakes*

car up level with the floor. The same operation takes place at the top landing. For clearness in the figure the leveling cams at the top floor have not been shown.

At the intermediate landings the operator must, on approaching a floor where a stop is to be made, bring the car under control, and when within a few feet of the landing bring the car switch to center, in much the same way as for the standard machine. Then when the car comes within 16 or 18 in. of the floor, the micro-machine is switched in automatically and the car brought level with the landing and stopped.

Fig. 4 shows the position that arms *A* and *A'* on the micro leveling machine are held in when the car is in normal operation, and Fig. 5 shows the position of the arms with the car stopped level with the floor.

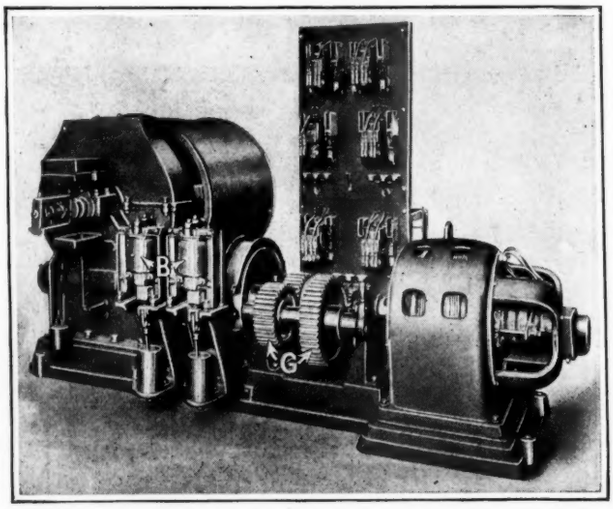


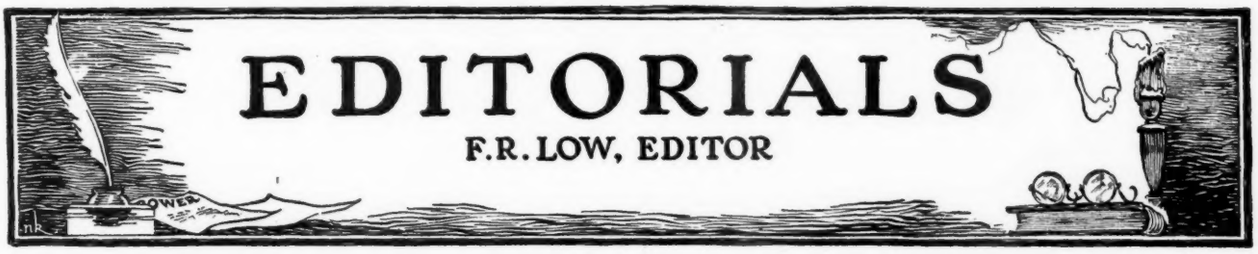

*Fig. 7—Heavy-duty drum-type machine with back gearing and two brakes*

If for any reason the car drops below the floor, arm *A* will strike the upper end of cam *C*, which will close the switch on the micro-machine for the up motion and the car is brought up level with the floor. On th other hand, should the car go a short distance abov the floor, such as would be the case when a heavy load is taken off, arm *A'* will strike the lower end of cam *C'* and the micro-machine is put in motion and brings the car down level with the floor.

Although in Fig. 3, the controller for the main machine only is shown, a controller is also provided for the leveling machine. On the main machine the control may be of the multi-voltage type, as in the figure, or of the variable-voltage or rheostatic types, where the micro-machine control is a simple rheostatic type.

The accuracy with which the micro-machine will maintain the car level with the floor will depend upon conditions. For passenger service where the micro-machine speed should be comparatively high, a ½-in. variation in the levels of the car at landing floors would be allowed. In freight service, where much slower car speeds are used, the variation would be not over ¼ in., while in general the car would be maintained absolutely level with the landing floor.

Another advantage of the micro-drive machine is the ease with which it may be adapted to lifting heavy loads, such as safes. Where the standard type of traction machine is used for this purpose, it is necessary to equip the machine with an additional brake, as in Fig. 6. With the geared-type machine it is necessary to have the machine arranged for back gearing as in Fig. 7, which shows a Warsaw Elevator Company's drum-type machine arranged for back gearing at *G* and equipped with two brakes *B*. In the micro-drive machine all that is necessary is to tighten the brake springs on the main machine so that the brake will have sufficient friction to act as a clutch in transmitting the power from the micro-machine, which is used to lift the load.




## Hoover Takes Over the Patent Office

COMMENTING upon the recent transfer of the Patent Office from the Interior Department to the Department of Commerce, Secretary Hoover announced the undertaking of a vigorous campaign for the removal of certain injustices toward American patentees and manufacturers which exist in the patent laws of many foreign countries.

One of the most onerous provisions in certain countries is that an American patentee is required to manufacture continuously in these countries under his patents or lose their protection. This is not true of foreigners holding patents in the United States. In fact, a foreign patentee by registering his patent in this country can hold it for seventeen years and prevent its manufacture here. The injustice is obvious. Not only has it deterred many manufacturers from exporting patented mechanical products, but it has also been responsible for a condition of secrecy regarding many such devices which, if given full publicity under patent protection, would have enabled the manufacturer to benefit by constructive comment.

It is hoped to adjust some of the inequalities at an international convention to be held at The Hague next October. With their case in the hands of the Department of Commerce, American manufacturers may feel assured that it will be ably and aggressively presented. Moreover, Mr. Hoover's enviable achievements with other divisions of his department promises much for the Patent Office under his leadership.

## "Pay As You Leave"

THERE recently stood on one of the principal streets of Philadelphia—perhaps it is still there—a war exhibition housed in a temporarily vacant store. In the window were various souvenirs of the World War—shell fragments, helmets, pistols, insignia, photographs, etc. A show card extended a cordial invitation to enter and view the larger exhibit within.

Accepting this hospitality, one was courteously received. The former store had been divided into two aisles by a railing running lengthwise of the room. Following the guiding arrow, the visitor strolled down the right aisle, viewing relics and feeling grateful to the philanthropist who endowed such an institution. Rounding the end of the rail into the other aisle, he started down the home stretch back to the door.

Not until he neared the door did the victim see a small table, carefully screened from observers in the first aisle. Behind this table sat a middle-aged woman with a predatory look in her eye. On the table lay several fifty-cent pieces (decoys for "suckers") and above, on the wall, a sign suggested: "If you have enjoyed this exhibition . . ." The average citizen dropped his coin with a sheepish grin and slunk out, hoping none of his friends would see him. Here was a perfectly legal scheme for preying on that well-known human weakness, the desire to get something for nothing.

But, this "pay-as-you-leave" game is not confined to exhibitions; it is found in engineering and every other line of work. An engineer needs equipment or apparatus to meet certain requirements. He knows that efficiency and reliability demand a certain grade of workmanship and material and a certain minimum of designing skill. In short, he knows what he wants, but the controller of the purse strings demurs and suggests a cheaper article. The material is not of the best and the workmanship rather sketchy, while the designer is evidently not too well versed in engineering knowledge, but the apparatus looks as though it would serve the purpose. Above all it is cheap! So it is bought. Later, when several times the initial saving has been squandered in repairs, inefficiency and general trouble, the victim, wiser and sadder, learns that it is cheaper to pay for the right article in the first place.

## Some Encouragement

WHEN American business began to approach a stable condition after the deflation following the war, the coal industry found itself with about double the capacity necessary to supply the country's needs for bituminous coal. Unlike in most other industries, the coal operators were unable to adjust their business to the new conditions immediately. Probably one of the most difficult conditions that had to be encountered was the inborn characteristic of the miner himself, "Once a miner always a miner." If the average industry closes down for any length of time, it finds difficulty to start again, as many of the old employees have found other jobs. But not so with the miner; it requires the closing of the mines with no hope of reopening to force him to look elsewhere for work.

While most industries have experienced a great increase in business which has absorbed their enlarged capacity, the consumption of bituminous coal has remained fairly constant. The increased use of water power, low prices of fuel oil and enhanced efficiency of fuel-burning plants have all contributed to keeping the consumption of coal from increasing and providing more jobs for the miners. In coal mining as in any other industries that pass through long periods of depression, it becomes a survival of the fittest, and the one who can most readily, by the adoption of improved methods, bring down the cost of operation to meet the new level of prices generally stands the best chance of weathering the storm. And this has forced an increased use of machinery in the mining of coal, which has increased the output per man and, with the consumption remaining practically constant, reduced the number of jobs for the miners. The consolidating of mining

interests and the forcing of many mines to close permanently have only helped to aggravate the unhappy position of the miner.

Present indications are that the industry is giving way before the economic law of supply and demand, and the miners instead of attempting to create jobs by insisting upon shorter hours and more pay, are seeking employment elsewhere. A noteworthy movement in this direction is that which has been going on in Indiana, where attempts are being made to place the idle miners in the steel industry. The readjustment process in the coal industry has been a long and hard-fought conflict for both miners and operators, as well as a discouraging and uncomfortable one for those who had to depend upon an uncertain and uncompromising mining fraternity for a coal supply. However, if economic pressure is forcing a stabilizing of the coal supply, something has been gained even at this late date.

## In Per Cent of What?

ENGINEERING literature abounds with the phrase "per cent" to such an extent that an additional explanation regarding a quantity so designated would often seem superfluous. The use of this term alone in connection with ratios, however, may easily mislead the reader or result in confusion as to its exact meaning.

Improvement in efficiency of any kind expressed in per cent offers a fertile field for inaccuracy. A designing engineer for instance, may set down on paper that by the use of an air heater and other means, the boiler efficiency is to be raised from seventy to eighty-four per cent, which would be a clear and understandable statement. After making the change he may write to know if the expected increase of fourteen per cent were realized—a question that may ordinarily imply several meanings.

The combustion engineer, however, observing that his original combined boiler efficiency of seventy per cent has been increased by fourteen, which is one-fifth, might say his gain in efficiency was twenty per cent, meaning twenty per cent of the original efficiency.

Also the change might be viewed in another light. Whereas, previously one hundred pounds of coal were required in order to realize the energy available in seventy pounds, afterward, however, the same amount of useful energy can be had by burning only about eighty-three pounds. The fuel bill is therefore seventeen per cent of the original less, which might also be called a gain of seventeen per cent. There is still the designer's viewpoint that fourteen per cent has been gained.

The difference of two efficiencies representing ratios of the same kind may be spoken of as an increase and not as a gain. The word gain can be restricted to represent a difference of similar ratios divided by the chosen one. Therefore an increase of fourteen per cent over the original seventy of efficiency could really be translated into a gain of twenty per cent.

Another and better way to prevent a similar misunderstanding, as well as to guard against other and possibly more complicated situations, is to define exactly how the quantity is derived that is given in per cent. Thermal efficiency, Rankine cycle ratio, etc., are terms whose meanings are widely accepted and need no other explanations as a rule. Increase, gain, change and similar words are usually insufficient in themselves, requiring further definition.

The phrase per cent therefore, should be preceded or followed by an explanation of how the ratio is obtained, whether it is Carnot or other standard efficiency; the difference of two similar ratios, the difference divided by the smaller, etc. It might be said, for instance, that the boiler change results in three kinds of gains, that of fourteen per cent difference in thermal efficiencies, twenty per cent of the original efficiency, or a saving of seventeen per cent of fuel originally required per unit of heat absorbed.

It would seem that such elementary matters should ordinarily take care of themselves, but it will be found on investigation that engineers are sometimes undesirably brief in their explanations, so that the reader is not clearly informed and some checking is therefore necessary in order to determine what is meant.

## Hardness Desirable in Turbine Blades

THE value of a material for turbine blades is frequently based on non-corrosive properties, convenience of manufacture, strength and cost, with the emphasis placed on one or more of these factors according to the conditions the vanes must encounter.

The value of hardness, however, is strikingly brought out in the test for resistance to erosion, as reported in this issue. Blading problems have been accentuated in the low-pressure or exhaust region, where greater strength is required to resist centrifugal force resulting from the longer relative vane lengths. Both erosion and corrosion tend to be increased on account of the presence of moisture and possibly higher vane speed. Hardness is an important quality of steels for such conditions, and in certain alloys it tends to produce both strength and a resistance to erosion.

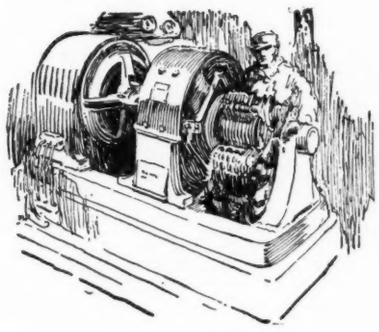
Alloy steel with a definite percentage of nickel, which is largely employed for this service at present, is ordinarily improved by suitable heat treatment. Undoubtedly, a certain degree of hardness is desirable, which distinguishes it absolutely from the relative softness as encountered in brass. The fact that strength and hardness together are desirable in the exhaust region places greater stress on the desirability of so-called stainless steels for this service.

It is a well-known fact that some chromium steels attain their resistance to corrosion principally when in a very hard condition. A high degree of strength also is obtained under these circumstances, so that from these two viewpoints there appears to be a definite possibility for this type of steel. The greater erosiveness of high-pressure steam accentuates the desirability of resistance to erosion.

The fact that corrosion and erosion are to a certain extent related, inasmuch as lack of one property may unfavorably affect the other, increases the value of a hard material that presents a low erosive tendency and also a high resistance to corrosion.

Unfortunately, the cost of the material or its unsuitableness to present manufacturing methods now stands in the way of development. It is not improbable that these objections may be lessened as time goes on. It must be remembered, however, that high physical strength combined with great hardness may present characteristics with regard to vibration and fatigue somewhat different from those of the more familiar materials. Complications, therefore, may be introduced requiring further investigation and refinement.

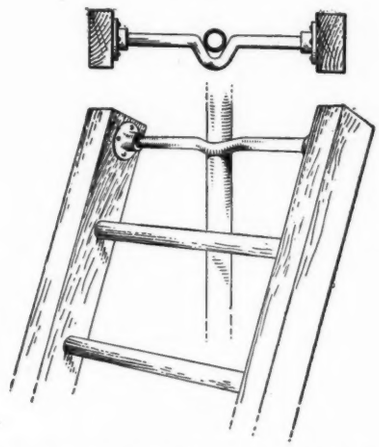
# Practical Ideas from Practical Men



WITH a view to stimulating engineers into the habit of recording for the benefit of brother engineers, unusual occurrences, how these were met and other practical expedients adopted in the operation of their plants, Power has decided to award two cash prizes each month during 1925. One of $25 for the best and another of $15 for the second best practical letter on plant operation or practical kinks received during the month. This is in addition to payment for the contribution at space rates. The winners for February will be announced next month.

## Preventing Ladder Sideslip

During the erection of a piping system including a number of upright connections, it was necessary to rest a ladder against the vertical pipes. An ordinary ladder, however, does not fit well in this position because the slighest side strain tends to throw it over on one side. For this reason we added an extra metal rung at the top, and while even this does not



*Shape of rung used to prevent sideslip*

make the ladder as safe as it would be if both ends were resting against the support, it effectually stops the sideslip.

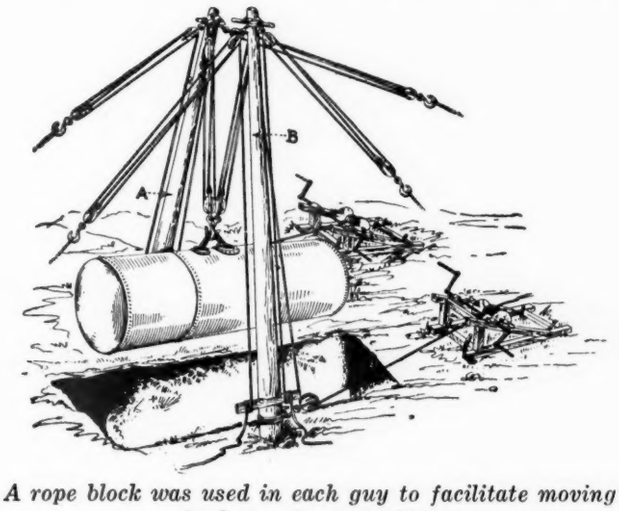
The rung was made of cold-rolled steel bent to a V-shape in the center as shown in the illustration. The flanges were drilled to take the rung and attached to the ladder by screws. HARRY MOORE.

Montreal, Que., Canada.

## Placing a Fuel-Oil Tank Underground

Some time ago I had the job of placing a fuel-oil tank underground. The tank had a capacity of 150 bbl. and was 7 ft. in diameter and 21 ft. long. Several laborers were detailed to excavate a hole 23 ft. long, 8 ft. wide and 8½ ft. deep. When a depth of 8 ft. was reached, the men struck quicksand and it was soon realized that it was useless attempting to go any deeper. It was also apparent that the tank would have to be lowered into place with as little delay as possible. As we had a number of rope blocks on hand, the method of handling the tank, shown in the illustration, was adopted.

Two gin poles were erected and guyed in three directions (some guys not shown for sake of clearness), a rope block being placed in each guy to facilitate moving the tank over to the hole as explained later. A cable was passed through the manhole and the vent opening a number of times to form a hitch for the blocks on to the boiler. As the tank was lying a few feet away from the excavation, the pole *A* was erected in an almost vertical position at the back of the tank, while the pole *B* was placed in a leaning position close to the opposite side of the hole. The tank was picked up by means of the two blocks and crabs after the balancing point was found. Then the leaning pole *B* was gradually straightened up and the pole *A* brought more in a leaning position until the tank was over the hole and could be lowered into the excavation. When the tank had been lowered into place and properly




*A rope block was used in each guy to facilitate moving tank over to excavation*

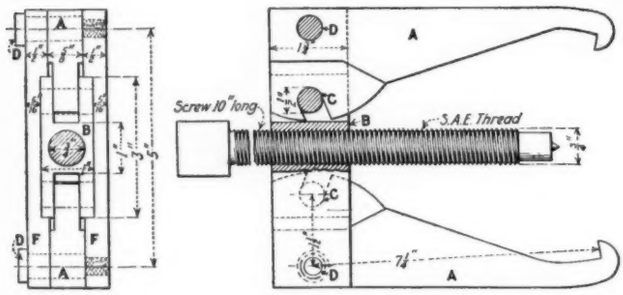
lined up, the men were instructed to fill in around the tank as quickly as possible. Before much filling had been done, however, the tank began to rise gradually, so the shoveling was stopped and a 2-in. water line was hurriedly connected and the tank filled with water. Then the filling-in was resumed, the water being left in the tank until we were ready to run in the oil. After some time the soil was well packed around the tank and over the top, and we had no more trouble.

Cincinnati, Ohio. ANTHONY A. FETTE.

## Improved Gear Puller

There are many different types of gear pullers available, but as they are invariably made of cast steel, some are found to be heavy and cumbersome. Another fault is the tendency to slip off the work unless held in place with clamps or clevices. The sketch shows a puller that automatically grips the work and prevents the jaws from from slipping. The illustration is self-explanatory.

The jaws *A* are forged from a good grade of tool




*Jaws of puller are self-adjustable and cannot slip off work*

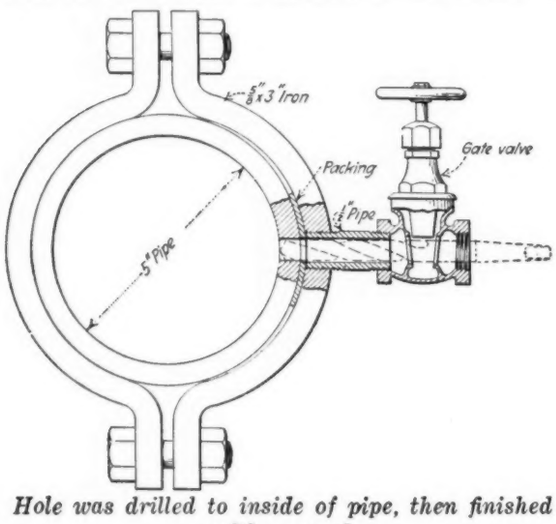
steel, and the nut *B* is milled from cold-rolled steel. The pins *C* and screws *D* are made from tool steel and hardened. The drawing screw should be made of a good grade of steel and hardened, care being taken not to warp the screw. The side plates *F* are also made from cold-rolled steel. The dimensions are given on the sketch, and pullers for different sizes of work can be made by making the parts proportionately larger or smaller.

R. A. KAPLAN.

Mankato, Minn.

## How Connection Was Made to Steam Line Under Pressure

Recently, we found it necessary to make ½-in. connection to a 5-in. steam line where it was inadvisable to shut the steam off on account of the severe cold




*Hole was drilled to inside of pipe, then finished with a punch*

weather. We had no boring and tapping machine such as are commonly used on water mains, so some other means of doing the job had to be devised.

A common pipe clamp was made in two halves from ⅝x3-in. iron, and a ½-in. pipe connection was tapped into one half. A close nipple and gate valve were tightened into this and the clamp tightened on the main, a piece of gasket rubber being put under the clamp at the place where the hole was to go through.

The gate valve was opened and a ratchet drill rigged up with the drill through the valve and nipple as shown in the illustration. After drilling deep enough to get a little steam, the drill was taken out and a slightly tapered punch with a sharp end was driven through the bottom of the hole. Then the punch was removed and the valve closed.

During the entire operation a man was stationed at the main valve so that the steam could have been shut off in an emergency.

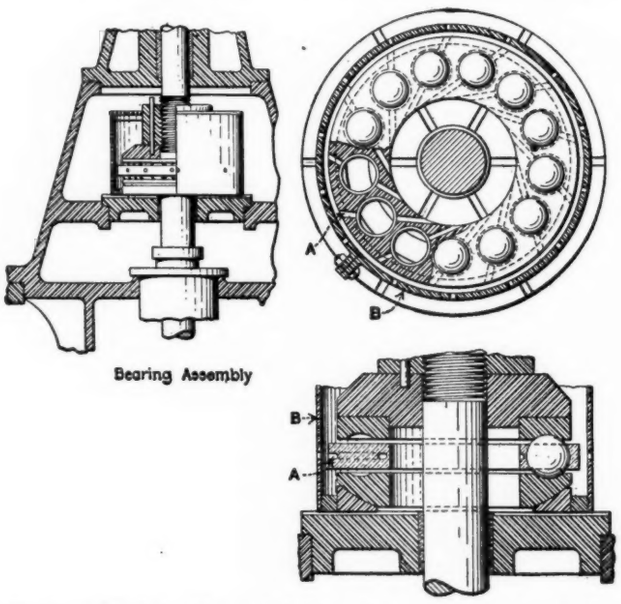
MELVILLE ODGERS.

Ely, Minn.

## Improvements Made in Ball-Thrust Bearing to Insure Positive Lubrication

The illustration shows the improvements made in a ball-thrust bearing of a deep-well pump to insure continuous and satisfactory lubrication.

The need for improvement in this bearing was realized from a succession of three wrecks, due to failure of the bearing from insufficient lubrication. As originally built, the bearing was supposed to run submerged




*Ports milled in the retaining ring cause a circulation of oil through the bearing*

in a bath of oil. When the pump was not in operation the bearing was fully submerged, but when operation began all trace of lubrication was thrown off the balls and races by centrifugal force, resulting in an absolutely dry bearing. Also, the oil in the pedestal of the pump took on a whirling motion from contact with the outer moving surface of the bearing. This left the bearing in the center of a crater formed in the body of whirling oil and caused it to operate with practically no lubrication. Under these conditions the life of the bearing was about two months, the balls finally cutting through the retainer partitions and climbing on top of one another with such force as to break the pedestal of the pump.

The improvement in the bearing, as illustrated here-

with obviates all tendency for the body of the oil to take on motion from the operation of the bearing. In addition, the ball retainer has been revamped and turned into a centrifugal pump whereby it picks up the oil in the center opening and forces it through ports *A* milled in the retainer, around each ball. The oil is then thrown outside of the small housing *B*, where it again enters the center opening of the bearing. In this way a continuous flow of oil is maintained through the bearing as long as the pump is in operation.

This improvement has greatly increased the life of the bearing and has entirely eliminated the possibility of the wrecking of the pump by a failure of this bearing while running at high speed. A patent covering these improvements in thrust bearings in their particular application to deep-well pumps was granted recently.

Hartford, Ill. GEORGE S. NEELEY.

## Armature Testing Set

Various methods for testing armatures have been developed. The test set here described can be easily made at small cost and is handy to apply. It will be found to be reliable, and in its use the condition of the armature coils is noted by the amount of sound heard in the head telephone receiver. This set will reveal the presence of short-circuits, open-circuits and of grounded coils or commutator bars.

If a coil is open-circuited, the sound in the receiver is very loud when the test terminals are on the bars to which this coil is connected. If a partial open-circuit exists, the sound will be not quite so loud as for a complete open-circuit. When the coil is short-circuited, the sound is low, a solid-circuit will give practically no sound in the receiver, a partial, or high-resistance short-circuit will give a low sound. All coils

*Fig. 1—Complete assembly of testing set*

that are O.K. will give a uniform sound, and there will be no appreciable difference in the sound as they are being tested. The tests for open-circuits and short-circuits are made by touching the test terminals on adjacent commutator bars. In testing for a ground, one of the test-terminal leads is held on the armature shaft while the other one is touched to each commutator bar. As the bar to which the grounded coil is connected is approached, the sound in the receiver diminishes, and when the commutator bar that has the grounded coil connected to it is touched, there is practically no sound in the receiver. On the commutator bars on each side of the grounded one, however, there is a certain amount of sound heard in the receiver. Upon locating the ground, this bar should be marked and the test continued around the commutator until the other side of the coil is located. The wires from the commutator

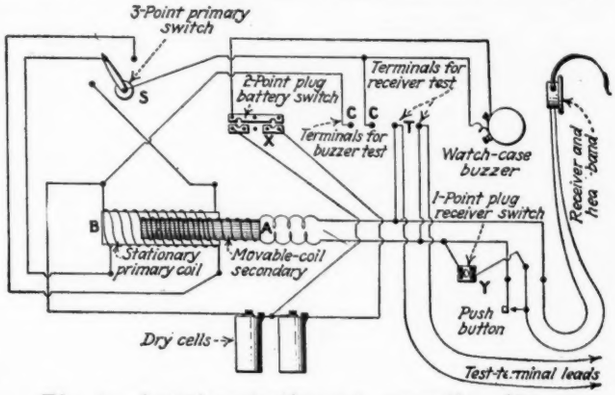



*Fig. 2—Armature-testing-set connection diagram*

are then removed and the grounded coil is cut out or repaired.

Fig. 1 is a photograph of the test set and Fig. 2 a wiring diagram. To make coil *A*, cut enough pieces of No. 18 soft-iron wire to form a core 6½ in. long by ½ in. in diameter. Insulate this core and wind on it two layers of No. 20 or No. 22 double-cotton covered magnet wire, leaving about ¼ in. of the core on each end without windings. This will bring the two ends of the wire out on the same end of the core. Solder a flexible lead on each of the ends. Coil *A* is made to slide inside of coil *B*.

Coil *B* is made by taking a cardboard tube, that coil *A* will just slide in and out of, and winding on it enough No. 14 enameled- or cotton-insulated magnet wire to make a 3-layer coil 6 in. long. From this coil bring out a tap connection for each layer, thus one-third, two-thirds or the whole of the primary coil can be used by moving primary switch *S*. By plugging in on battery switch *X*, one or the two dry cells are connected to the primary coil. By plugging in on receiver switch *Y*, the receiver is cut in constantly. If receiver switch *Y* is left open, the push button can be employed to cut the receiver in and out at will. By changing the test-terminal from terminals *T* to *CC*, a buzzer test can be obtained. Coil *B* is mounted on a suitable base, and coil *A* is put inside of it and arranged so as to be moved in and out of coil *B*.

The battery current flows through the watch-case buzzer and is there converted into a pulsating or interrupted current. The buzzer is in series with coil *B*, and the current in this coil induces a current in coil *A*. The telephone receiver has 75 ohms resistance and is fitted with a head band so as to leave both hands free to make the test. The receiver is connected across the terminals of coil *A*, and the testing terminals are connected in parallel with the receiver.

The volume of sound in the receiver may be varied by moving coil *A* in or out of coil *B*. The amount of adjustment needed will depend on the size and style of armature being tested. Adjustments are also made with the primary switch *S* and the battery switch *X*. A little practice will enable anyone to detect faults easily by the sound in the receiver.

San Bernardino, Calif. FRANK HUSKINSON.

# Comments from Readers

## Wax Coating of Automatic Sprinklers Not Advisable

At the bottom of page 178 of the Feb. 3 issue, is a short article regarding wax coating of automatic sprinklers. This article, while well-meant, may if its suggestions are followed, lead to the premature opening of sprinklers and consequent water damage and possible interruption of business.

The experience of the Factory Mutual Laboratories, covering more than thirty years of sprinkler testing, would not confirm the recommendations given in the article. The protective covering described will harden with age as the oil oxidizes and may prevent the operation of the sprinkler just as effectively as corrosion. Moreover, dipping sprinklers which are rated to fuse at about 160 deg. into a solution heated to 180 to 200 deg. is unwise advice, as it is almost certain to weaken the soldered joint, even if quickly dipped as suggested. If the dipping is prolonged to five seconds, the sprinklers will open.

C. W. MOWRY, Director,
Boston, Mass. Factory Mutual Laboratories.

## Temperature Rise in Motors

In your issue of Jan. 27, H. B. Hodgins comments on the matter of motor heating as discussed in an article, "Operation of Three-Phase Induction Motors Under Abnormal Supply Conditions," by C. F. Bowman and the undersigned, which was abstracted in the Dec. 16, 1924, issue. In reply to Mr. Hodgins' question, I may state that in making the test, the thermometers were located on the live coils and the motor temperatures were also checked by resistance measurements.

Mr. Hodgins is quite right in saying that the loss in the active phase would be 144 per cent of what it should be under normal operation, provided the current was 120 per cent of rated current. While it is true that the loss is higher in the active phase than under normal conditions, it should be remembered that the temperature rise is a function not only of watts dissipated, but also of temperature gradient between active copper and surrounding objects. Therefore, while the heating loss might be 144 per cent of normal, the actual temperature rise would be considerably less. In the low-voltage motors of the type tested, the stators were delta-connected and, therefore, there were currents in all three phases. This, of course, results in better distribution of heat than if one phase only of the motor were operative. In Y-connected stators one-third of the copper would be inactive, but this inactive copper would by its presence, serve to reduce the temperature rise for a given heat loss in the active coils.

Mr. Hodgins' statement relative to the deterioration resulting from excessive heating in continuous service is correct. We agree with him that a short-time test with excessive heating might not damage the motor, but that continuous service under this condition would result in damage. However, the ratings for the motors described in our article were safe ratings for the motors which we tested. These motors were selected at random from a group of new commercial machines.

Lafayette, Ind. D. D. EWING,
Professor of Electric Railway Engineering,
Purdue University.

## Dry Steam and Blowdown

The arguments in the editorial,[1] "Blowing Down a Boiler through the Steam Nozzle," are correct provided it is assumed that superheaters are used. Then the dust resulting from the evaporation of the moisture in the steam is carried through the whole system with the deleterious effects Mr. Andrews points out.

However, many of our small plants and heating boilers operate without superheaters. Much of the moisture carried over by the steam settles in the pipe lines and is removed by traps, or by a return system such as the Holly. When traps are used, their discharge is delivered to the feed-water heater and is generally returned by the feed pump to the boiler without further treatment. Either the traps or the Holly system will return much of the impurities to the boiler and are therefore not strictly forms of blowing down in the sense that the boiler concentration is substantially lowered. Consequently greater amounts of water must be blown down through the blowoff valve, resulting in a loss of heat which costs money.

Mr. Andrews suggests that absolutely dry steam is a remedy for the troubles due to impurities carried over with the steam, and he is absolutely correct in this stand. The heat losses in the blowoff can be utilized to provide evaporated makeup by means of the continuous blowdown of the boilers as pointed out in my article on "The Utilization of Heat Head."[2]

Baltimore, Md. A. G. CHRISTIE.

## Loading of Elevator Cables and Bearings

In the article by Charles A. Armstrong in your March 10 issue, beginning on page 371, the author says: "It is general practice to make the counterweight equal to 40 per cent of the weight of the car and its rated load." This statement is not correct. The counterweight is made heavier than the car by an amount that is from 30 to 40 per cent of the rated load. The weight taken for a passenger car in the article is low. It usually runs from 2,500 to 3,000 lb., and some cars weigh as much as 5,000 lb. I should estimate that the cars in the New York Public Library may possibly weigh 10,000 lb.

With a 3,000-lb. car and a 3,000 lb. load, a counterweight of 30 per cent overweight would weigh 4,000 lb. If the machine was placed in the basement without a car counterweight, the total overhead load would be

[1] Jan. 6 issue, discussing article "The Physical Side of Concentration in Boilers" in the same issue.

[2] Published Dec. 2, 1924.

20,000 lb. With the machine weighing 8,000 lb., the load on the overhead beams by placing the machine overhead would be 2,000 lb. less than with the basement installation. The car counterweight is made to weigh less than the car by about 300 to 500 lb. This amount varies with the speed of the elevator. With the basement-type machine, the reduction in overhead loads by using a car counterweight is equal to double the weight of the car counterweight.

It might be well also to call attention to the fact that with the double-wrap traction the friction due to the loads on the main driving-sheave shaft and the idler-sheave shaft are three times as great as with the single-wrap traction method.

HOWARD B. COOK, Elec. Eng.,
Cincinnati, Ohio. The Warner Elevator Mfg. Co.

## Get Started

The last sentence of the last paragraph of the Foreword in the Feb. 10 issue does not come true every time, as was the case with "Bill" Bagley.

Several years ago Bill took charge of a 2,000-hp. plant. The equipment included seven 3,000-sq.ft. water-tube boilers, turbo-generators, air compressors, etc. The superheater headers were bare as well as the main steam header, and in fact, about 2,000 sq.ft. of steam pipe was uncovered. The plant was equipped with forced-draft chain-grate stokers, on which anthracite was used, the forced draft being furnished by two engine-driven fans. All the dampers were controlled by hand, and one boiler had no damper at all. Numerous air leaks were to be found in boiler settings and steam leaks in the pipe lines.

When Bill took charge, he rigged up some home-made draft gages, covered steam pipes in his spare time and plugged the leaks in the furnace walls. He pleaded with the manager for damper regulators and other necessary instruments and showed him that he was trying with crude home-made apparatus to improve the operation of the plant. He did reduce the coal consumption about five tons a day, but the manager just smiled, promised him better equipment and promptly forgot it.

Why is it so hard to sell the idea of fuel economy to the average power-plant management? Any man that is worthy of the name of engineer wants to improve his plant. He will do it with what he has at hand or what he can make himself, but he at last reaches a point where he can go no farther without help from the office. The big question is, Why don't they help?

Wilkes-Barre, Pa. THOMAS M. STREET.

## Interference by Untrained Superiors

Occasionally, we find in charge of a plant a man who perhaps through lack of training is a source of annoyance to the orderly operation of the plant.

I recall one case of interference by an untrained superior that cost the firm considerable money. I was operating engineer at the time, in a plant that supplied light and power for several country towns. The generating equipment consisted of reciprocating engine and turbine-driven units.

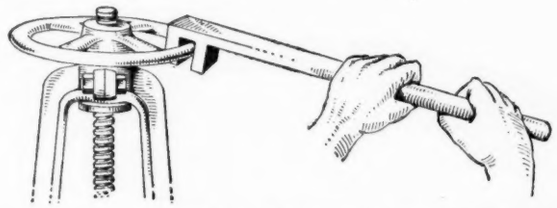
One evening just as I had brought a 1,000-kw. turbo-generator unit up to speed preparatory to putting it in parallel with a reciprocating engine-driven unit, my immediate superior appeared on the scene. He was a man of wide experience in mill operation, but had had little or no experience with generating units. As I walked toward the switchboard to synchronize the machines, he reached out his hand with the words, "You put this switch in now," and rammed down the switch with a resulting roar from the generator. I was only a second behind him and I opened the switch immediately, but the damage had been done. The rotor shaft had been sprung, causing sufficient vibration to necessitate taking out the rotor and sending it to the factory to be straightened.

Undoubtedly many other instances could be cited where a man, possibly through wide experience in general engine or boiler operation, obtains a position where he has supervision over equipment with which he is unfamiliar and later proves a serious detriment to the successful operation of the plant as a whole.

Brockton, Mass. FRANKLAND CHENEY.

## How To Keep Gate Valves Tight

With reference to the articles in the Oct. 14, 1924, and Jan. 20, 1925 issues entitled, "How to Keep Gate Valves Tight," I should like to indorse the principle mentioned of working the wedges back and forth, but believe the caution sounded with respect to not forcing the valves owing to danger of breaking the bonnet, to



*Wrench used in forcing valves that were badly scaled*

be exaggerated. Any standard make of valve will give way under forcing, not in the bonnet, but in the handwheel, stem, yoke, or some other part.

As an instance of severe usage valves have been known to stand, the following is given.

In a plant where large quantities of water are heated to over 300 deg. F. and pumped through a network of lines, there were over one hundred 6-in. gate valves. Untreated water was used, and at times this carried large quantities of scale-forming salts that would form a layer of hard scale an inch thick in four or five weeks. This had to be removed with turbine cleaners at regular intervals, making it necessary to keep all the valves in good condition so any section could be bypassed and cut out for cleaning at any time. Accordingly, every week each valve was opened and closed several times to break the scale loose. This was accomplished by placing a handwheel wrench, as shown in the illustration, on the wheel and exerting a steady pull while the end of the stem was struck with a 4-lb. hammer. A brass striking block was used to prevent injuring the stem. In this way the valve was gradually closed until it remained open very slightly. Then it would be opened a few turns and bleeders opened, allowing water to rush through and wash out the scale. After blowing out, the valve would be closed a little more, then opened up and the process repeated.

This method of closing is, of course, not recommended for obtaining long life of gate valves, but shows what a standard make of valve will stand if conditions make necessary such severe handling.

Gulf, Tex. C. L. ORR.

# Questions and Answers

*Conducted by*

## Franklin Van Winkle

### Appearance of Burned Boiler Sheet

*How can it be known whether the fire-sheet of a boiler has been burned from low water?* D. W.

The fire side of a sheet or tube that has been burned will present a blistered or spongy appearance, and overheating usually warps the material out of shape, causing leakage at tube ends. Scale on the interior of the boiler becomes loosened from the overheated material and the surface becomes coated with a bright red iron oxide.

### Latest Cutoff with Single Eccentric Corliss Engine

*Could a single-eccentric Corliss engine have cutoff at exactly one-half stroke?* L. F. M.

On account of angularity of the connecting rod, less than one-half stroke from the crank end of the cylinder is accomplished for revolution of the shaft and eccentric through 90 deg. Since cutoff must occur before the wristplate swings farthest to one side of the central position, the cutoff on the crank end must be less than one-half, unless the eccentric is set less than 90 deg. ahead of the crank with negative lap of the steam valves and tardy action of the exhaust valves.

### Engine Clearance

*What is meant by clearance of an engine, and how can it be reduced?* C. C. T.

The term clearance is used with reference to mechanical clearance and also with reference to volumetric clearance. When used to signify mechanical clearance, it refers to the linear distance between the nearest points of the cylinder head and piston when the piston is at the end of its stroke. In this sense it is commonly designated piston-travel clearance or simply "piston clearance," and is expressed in inches.

When the term clearance is applied to volumetric clearance, it refers to the volume of ports and passages from the faces of the valves to the cylinder and the connected spaces in the end of the cylinder inclosed between the cylinder head and face of the piston when the piston is at the end of its stroke. Volumetric clearance is commonly designated "cylinder-volume clearance" and is expressed as a percentage of the piston displacement or volume swept through by the piston.

Both piston clearance and cylinder-volume clearance of an engine would be reduced by making the piston longer or by having the cylinder heads project farther into the cylinder. Either kind of clearance would be reduced in the head end by increasing the length of piston rod or connecting rod, which at the same time would increase the clearance in the crank end of the cylinder. By shortening the piston rod or connecting rod, the clearance would be reduced in the crank end and increased in the head end of the cylinder.

### Cracking of Tube Sheets

*What causes cracks in a tube sheet between the tube holes?* H. J. T.

Such cracks sometimes are started from tearing action of tools used in preparing the tube holes, and the fractures follow deeper from application of excessive force in the use of tube expanders. From alternate heating and cooling of the sheet a crack of the kind, once started, is likely, sooner or later, to extend clear across a ligament between two tube holes.

### Warming by Exhaustion of Room Air

*Heating of our shop is performed by exhausting the air and drawing a fresh air supply over steam-heated coils. Would not the heating be performed more efficiently by forcing heated fresh air into the rooms?* H. E. G.

The heating would be accomplished with better efficiency by forcing the heated air over the coils into the rooms. By exhausting the air from the rooms there may be more cold air drawn through openings and crevices than necessary for good ventilation. However, exhaustion of the air may be necessary for removal of dust or foul air from machinery or from locations where the atmosphere cannot otherwise be maintained suitable for operatives. When that is the case, the sections requiring the use of exhausters should be partitioned off tightly from other rooms to prevent direct infiltration of cold air to the latter, to the exclusion of warm air furnished by the heating unit.

### Wear of Cylinder and Piston

*Why does a cylinder wear more in the center than at the ends; and which receives more wear, the piston or the cylinder?* J. J. H.

The parts of the cylinder covered by the piston at each end of the stroke are the only parts of the cylinder that are not rubbed twice by the full length of the piston during a revolution of the engine. Therefore the wear from the piston is less at the ends than at the middle of the cylinder.

When the piston, packing rings or other rubbing parts, are made of material of the same hardness and toughness as the cylinder, the total amount of material worn from the cylinder is the same as the total amount worn from the piston or packing. Since the rubbed surface of the cylinder bore is longer than the piston, removal of the same amount of material from each causes greater reduction of the diameter of the piston material than increase in diameter of the cylinder bore. However, when the cylinder is roughly bored or is made of coarse-grained material, cylinder packing rings of only the same hardness may exert a scraping or cutting action to wear away the cylinder faster than wear of the piston and its fittings.

## Reducing Proportion of Load on Low-Pressure Cylinder

*How can the proportion of load carried by the low-pressure cylinder of a two-cylinder compound engine be reduced?* *F. R.*

The proportion of load carried by the low-pressure cylinder will be reduced by increasing the length of cutoff of that cylinder. This causes less back pressure on the high-pressure cylinder and results in development of larger proportion of the power in the high-pressure cylinder.

## Stress on Screw Threads of Different-Shaped Pipe Caps

*If a pipe 20 in. diameter is closed at one end with a flat cap screwed over the outside of the pipe, and at the other end is covered with a dished cap screwed over the outside with the convex side of the cap toward the interior of the pipe, which cap will have its screw thread subjected to greater stress from pressure within the pipe?* *M. D.*

The pressure per square inch of exposed surface of each cap will be the same, and as the dished surface will have greater area, the total pressure acting over its whole surface will be greater, but the resultant pressure resisted by the screw threads would be the same in each case, regardless of the form of the cap surfaces. If this were not true, greater force acting on the screw thread at one end of the pipe than the other would have a tendency to change the position of the pipe.

## Setting Eccentric of D Slide-Valve Engine

*What is the method of setting the eccentric of a D slide-valve engine?* *A. T. S.*

Remove the steam-chest cover and before undertaking to set the eccentric in its final position on the shaft, find whether the center of the valve travels the same distance on each side of the center between the ports. For that purpose turn the engine over with the eccentric set on the shaft at any angle with the crank, or loosen the eccentric from the shaft and swing it clear around the shaft, marking the valve seat to indicate the greatest amount of travel of the ends of the valve beyond the outside edges of the ports. If the amounts of overtravel are not the same, they should be made so by adjustment of the length of the valve stem or eccentric rod.

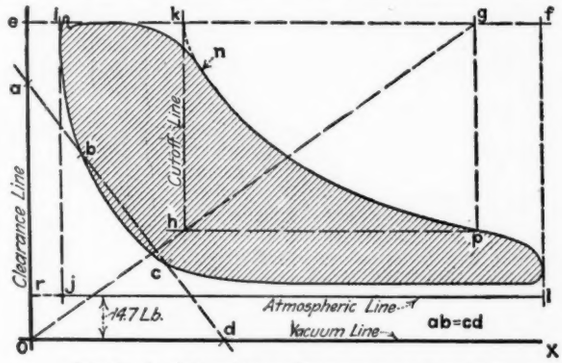
When equalized, place the crank on a dead center and swing the eccentric around the shaft in the direction the engine is to run, until the edge of the valve begins to uncover the port of that end of the cylinder which should take steam for the beginning of a stroke. Then temporarily set the eccentric on the shaft and turn the engine forward until the crank comes to the other dead center, and if the valve was accurately centered, the amount of valve opening will be the same for the end that then should admit steam as it was for the first dead center. If the leads are not equal, take out one-half of the difference by adjusting the length of the valve stem. If the desired amount of lead is not obtained when the leads are thus equalized, loosen the eccentric and turn it around the shaft in the direction of forward rotation of the engine until the desired amount of lead is obtained; make a light mark on the side of the eccentric to correspond with a mark on the shaft and set the eccentric fast on the shaft. Then, if all operations have been carefully performed, there should be the same amount of lead of the other end of the valve when the engine is turned forward and the crank is brought around to the first dead center.

## Determining Per Cent of Clearance and Cutoff from Indicator Diagram

*How are the percentages of cylinder clearance and theoretical cutoff of an engine determined from an indicator diagram?* *R. T.*

The method of determining the percentage of cylinder clearance volume from the compression line of a diagram, and the theoretical point of cutoff, based on a point in the expansion line, are shown in the illustration.

First locate the vacuum line *OX* parallel to the atmospheric line and 14.7 lb. below it, according to the scale of the indicator spring used in obtaining the diagram. Draw a straight line *abcd* across the compression curve cutting *OX* at *d*, and from *b* set off




*Method of locating clearance and cutoff*

$ab = cd$. Then $aO$ drawn perpendicular to $OX$ will be the clearance line. Draw $ij$ and $lf$ tangent to the ends of the diagram and perpendicular to the atmospheric line, and draw $ef$ parallel to the atmospheric line to represent the initial pressure. Assuming that $jl$ or $if$ represents the volume displaced by a stroke of the piston, $ei$ or $rj$ would represent the cylinder clearance volume and the percentage of clearance would be $rj \times 100 \div jl$.

To find the theoretical percentage of cutoff, selecting any point $p$ in the expansion curve, preferably near the point of release, erect the perpendicular $pg$ and draw a diagonal $gO$. Then from $p$ draw $ph$, parallel to $OX$ and through $h$, the point of intersection of $ph$ and $Og$, draw a vertical line $hk$. This will be the cutoff line. The theoretical point of cutoff for the assumed initial pressure and point $p$ will be at the intersection $k$, and the percentage of theoretical cutoff will be $ik \times 100 \div jl$. The point $k$ sometimes is called the commercial or equivalent point of cutoff, to distinguish it from the actual point of closure of the admission valve, which occurs at a point $n$ where the actual diagram, rounded from $i$ to $n$ due to gradual closing of the admission valve, changes to the expansion curve $np$ after the valve is completely closed.

[Correspondents sending us inquiries, should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—Editor.]

*A new slant on things observed in and out of the power plant*

# What Happens and Why?

## Auxiliary Drive and the Heat Balance

FOR some years there has been frequent discussion of the relative merits of steam and electric drive for auxiliaries in central stations. It has been clearly demonstrated that in a station devoted solely to power generation the heat balance is almost invariably improved by electric drive, assuming that bled steam is available for feed-water heating. The result has been a steady swing toward this type of drive except where considerations of dependability or first cost outweighed the obtainable increase in plant efficiency.

The isolated plant, as a rule, manufactures both power and heat. Considering only a non-condensing plant, the electrification of auxiliaries can produce no fuel saving during periods when the demand for exhaust steam would in any case exceed the supply. On the other hand, electric drive can produce a definite fuel saving during all periods when exhaust steam is being wasted. The extent of these periods is one of the prime factors in determining the advisability of electric auxiliary drive. The term "auxiliary drive," as used here, includes all small unit drives, whether in the power plant or the manufacturing plant, while exhaust-steam demand includes the steam needed for feed heating.

### Comparison Based on Fixed Output of Power and Auxiliary Drive

The accompanying simplified heat-balance diagrams show the saving graphically for a specific set of assumptions. Incidentally, both these diagrams are drawn "backward," starting in both cases with the fixed requirements of 100 energy units of electricity for outside use and 5 units at the shaft of the auxiliaries. It is assumed that the main unit turns 10 per cent of the energy supplied into electricity, leaving 90 per cent in the exhaust.

The steam auxiliary drives are assumed on an average to deliver 2½ per cent of the throttle energy to the driven shaft, the other 97½ per cent leaving with the exhaust. Over-all boiler efficiency is taken at 70 per cent. It is also assumed that of 7 energy units dispatched to auxiliary motors, 5 units are delivered to the driven shaft, 2 being lost in motors, wiring, etc.

The exhaust-steam requirements for various seasons, are indicated on the right in the same units.

Starting with *A* of Fig. 1, it is evident that *B* must be 1,000 and *C* 900, since the main unit turns into electricity 10 per cent of the energy supplied. Likewise, since the steam auxiliary drives turn 2½ per cent of the energy supplied into shaft power, the output *D* of 5 requires an input *E* of 200 and an exhaust *F* of 195. Adding *F* and *C* gives the total exhaust *G*.

Working back toward the fuel, *E* and *B* add up to give 1,200 for *H*. With 70 per cent boiler efficiency *I* becomes 1,715 and *J* 515.

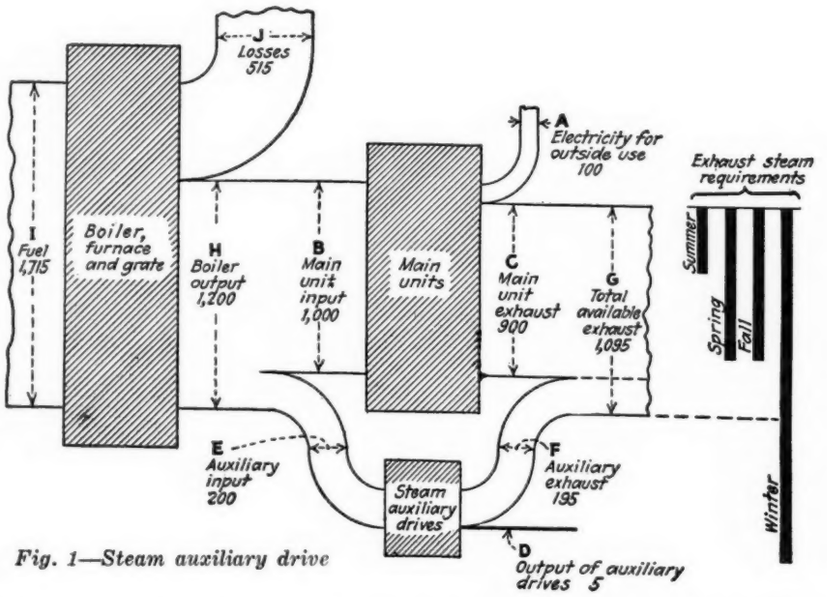



*Fig. 1—Steam auxiliary drive*

The most important thing to note in Fig. 1 is the large stream *F* of exhaust energy (a dead loss during three seasons) that must be produced in making *D* by individual steam drive. Electric drive (Fig 2) throws the making of this power back on the main unit, where it can be done with much less production of exhaust.

Of the 963 exhaust energy units shown in Fig. 2, 900 come from the production of 100 units of outside electricity and the other 63 from the production of 7 units of current to produce 5 at the driven shafts of the auxiliaries.

Electric drive is therefore responsible for a cut of 195 — 63 = 132 energy units, or 12.05 per cent of the total exhaust. During the winter months this represents no actual saving since just that much more live steam energy must be used for heating. During the other three-fourths of the year, however, this is a clear saving.

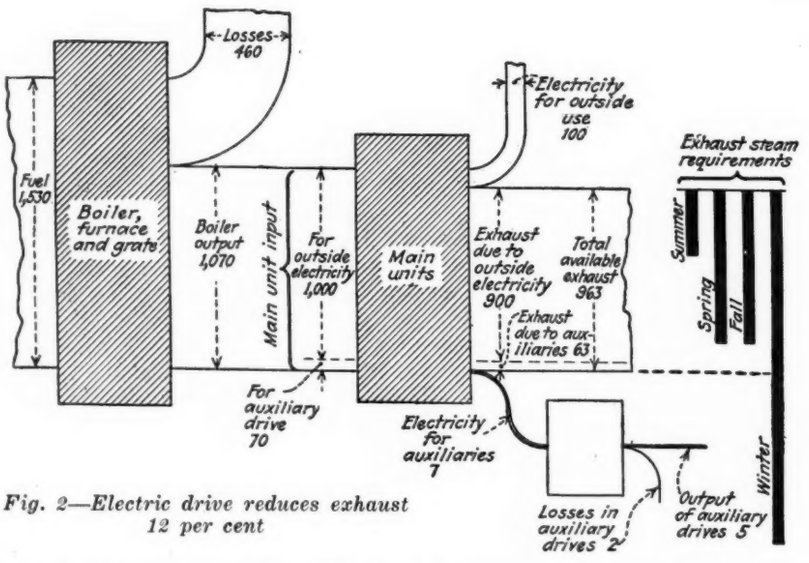



*Fig. 2—Electric drive reduces exhaust 12 per cent*

# Effects of Impurities in Storage-Battery Electrolyte*

By G. W. VINAL and G. N. SCHRAMM
United States Bureau of Standards, Washington, D. C.

THE satisfactory operation of a storage battery is in a large measure dependent upon the physical and chemical properties of the electrolyte that it contains. Considering the diversity of the service that they have to perform, it is increasingly important that the physical and chemical properties of the electrolyte should receive more extended study.

For a number of months experiments have been in progress at the Bureau of Standards to determine quantitatively the effect produced by various impurities on the rate of sulphation of storage-battery plates. The method involves a determination of the weight of the plates while suspended in solution.

Various impurities were added to the pure electrolyte 1.250 specific gravity, and the effects produced judged by the change in weight of the plates.

### Impurities Affecting the Negative Plates Only

The impurities that affect the negative plates only may be divided into two classes:

A. Impurities that are deposited quickly in the metallic state upon the negative plates and produce appreciable gassing. These include platinum, copper and silver. A closed circuit exists between the underlying lead of the plate and the impurity that is deposited upon it. Lead sulphate is formed in proportion to the quantity of electricity flowing and the plate gains in weight. Hydrogen is liberated at the surface of the impurity. The local action produced by these impurities proceeds at a fairly rapid rate until the ultimate capacity of the plate is exhausted. A considerable part of silver and copper, which is deposited on the plates as a spongy or tree-like mass, subsequently falls off so that the gain in weight of the plates represents chiefly lead sulphate. These impurities cannot be eliminated by changing the electrolyte in the battery, but their effect may in some cases be mitigated. Platinum is one of the most deleterious of impurities. Extremely small amounts are sufficient to produce rapid sulphation of the plates. Copper produces less effect.

B. The second class of these impurities includes those chemical compounds that are reduced more slowly at the negative plates and result in little, if any, perceptible liberation of hydrogen. In some cases these impurities can be eliminated from a battery by replacing the electrolyte.

Bismuth presents an interesting example of the reduction produced at the negative plates accompanied by the deposit of the bismuth itself as a brown powder on the plate. Bismuth trioxide reacts with sulphuric acid to form bismuth sulphate, and this, in turn, is reduced at the negative plate to bismuth with the formation of an equivalent amount of lead sulphate. No appreciable effect was produced by the bismuth on the positive plates. The local action produced by the bismuth that is deposited in the pores of the negative plates is relatively slow, but the diffusion of the electrolyte into the plates is doubtless impeded with a consequent loss in the available capacity.

Antimony and arsenic, like bismuth, affect the negative plates, but are without apparent action at the positive plates. Antimony in particular produces a rapid discharge of the negative plates. This effect is less in the case of arsenic. The presence of either antimony or arsenic in the electrolyte is also detrimental because of the possible formation of stibine or arsine in the presence of hydrogen. These poisonous gases, escaping from the cells, become a serious hazard to those using the battery.

Nitrates which were added to the solution as nitric acid were reduced at the negative plate and produced a marked increase in the rate of sulphation. Even so small a quantity as 0.001 per cent produced a measurable result. Small quantities of nitrates probably do little permanent damage, as they are gradually eliminated from the cell as oxides of nitrogen or reduced to ammonia. Nitrates were without effect in the experiments or pasted positive plates, but their use as a corrosive agent in forming plante plates from sheet lead is, of course, well understood.

PURITY OF SULPHURIC ACID SOLUTIONS FOR BATTERY USE

| | Concentrated Acid | Unused Electrolyte | Used Electrolyte |
|---|---|---|---|
| Specific gravity 60 deg. F. | 1.835 | 1.280 | 1.280 |
| Per cent $H_2SO_4$ | 93.19 | 36.8 | 36.8 |
| Color | Colorless | Colorless | Colorless |
| Suspended matter | None | None | Lead compounds only |
| Platinum | None | None | None |
| Arsenic and antimony | Traces | Traces | Traces |
| Manganese | Trace | Trace | Trace |
| Iron, per cent | 0.010 | 0.004 | 0.015 |
| Copper, per cent | 0.005 | 0.002 | 0.005 |
| Nitrates and nitrites | Traces | Traces | Traces |
| Chlorides calculated as Cl | Trace | Trace | Trace |
| Organic matter | Trace | Trace | Trace |
| Sulphurous acid | Trace | Trace | None |

### Impurities Affecting Both Positive and Negative Plates

Iron is perhaps the most common impurity in storage-battery electrolytes. It is oxidized at the positive plate and reduced at the negative plate without depositing on either ad infinitum. Since it stays in solution it can be eliminated by changing the electrolyte. Manganese is more detrimental to the positive plates than to the negatives.

Chlorine is a detrimental impurity for both the positive and negative plates although in small quantities its effects are more pronounced on the positives. Chlorine is liberated at least in part from the cell, but others have stated that a portion of it is oxidized to perchloric acid and this remains in the electrolyte.

### Impurities Affecting Positive Plates Only

Impurities of this class are organic compounds. In the experiments with acetic acid the effects produced were smaller than were anticipated, and several more portions of acetic acid were added to the same jar at intervals without much effect.

### Local Action Produced by Combination of Impurities

The effects produced on negative plates by combinations of impurities which, taken singly, produced less effect than when present in combination were determined. The action of such combination as tungsten and copper exceeded materially the effects of either of these materials singly.

In addition to the experiments on tungsten and copper, combinations of copper with other impurities such as mercury, molybdenum, zinc, arsenic and antimony were tried. In all these cases it was found that the rate of sulphation of the negative plates were greatly accelerated. These results are significant in showing that it is important to limit the percentage of copper that may be present in the electrolyte to the smallest reasonable figure.

In the course of the experiments combinations of tungsten with arsenic, antimony, and several other impurities were tried, but the tungsten produced no unusual effect except when in combination with copper.

### Impurities Producing Little or No Effect

In the course of the experiments a number of impurities were tried that produced little or no effect on either the positive or negative plates. These included sodium, calcium, magnesium, aluminum, zinc, cadmium and mercury.

At various times sodium and magnesium sulphates have been suggested as an addition to sulphuric acid of the ordinary electrolyte to decrease the sulphation of the plates. Results obtained when these materials were added to 1.250 specific gravity electrolyte indicate that these substances are without effect on the rate of sulphation in concentrations up to 5 per cent, and no benefit is to be derived by adding them to ordinary solutions. Others have claimed that the presence of sodium sulphate and similar substances is harmful, resulting in the disintegration of the negative plates.

Specifications for battery acid have been issued by many different agencies, and a comparison of them shows wide

*Abstract from a paper, "Storage Battery Electrolytes," presented at the Midwinter Convention of the A.I.E.E., New York City, Feb. 9 to 13, 1925.

divergence in the impurities that are listed and the maximum amounts that may be considered permissible. If suitable specifications for sulphuric acid for use in batteries can be formulated and receive general recognition, it is likely that they will find use also in other industries. The amount of concentrated sulphuric acid used per year for batteries in this country is probably in excess of 30,000,000 pounds.

If the amount of impurities allowed by the specifications is made too small, serious difficulty may be encountered in finding acid sufficiently pure to meet them. On the other hand, the specifications must limit the impurities to satisfactory battery operation.

Specifications are usually drawn to apply to the concentrated acid. If pure water is used to dilute this to the proper concentration for battery use, the percentage of the impurity will be proportionately reduced. It is desirable that water of a high degree of purity be used, and no general statement as to the permissible use of natural water can be made for the reason that its purity varies from place to place and from one time of the year to another.

The table on the purity of sulphuric acid and solutions for battery use, has been taken from a recent book on storage batteries.[1] It is believed that this table is consistent with the results of this investigation and represents acid that can be readily procured. It may be desirable, however, to limit the amount of copper to a smaller percentage in view of the large local action that it produces when present together with certain other impurities.

Th term "trace" is often used, but ill-defined. In general this term in these specifications should be regarded as meaning less than 0.001 per cent. Any standard specification of this character should include also a statement of the tests to be employed.

Our experiments have shown that there are other impurities, in addition to those included in the table, which produce effects in the storage battery. However, they are rarely present in sulphuric acid. It does not seem necessary to name them all, as a statement can be added calling attention to the fact that other impurities are absent.

The limits for impurities given in the table are presented for discussion, and it is hoped that they may serve as a basis for specifications that will receive general recognition.

[1]"Storage Batteries," by Vinal, page 120 (1924).

# Power in Pennsylvania

IN AN address before the third annual Hydro-Electric Conference held at Philadelphia on March 10, held under the auspices of the Philadelphia Engineers Club, Charles Penrose[1] analyzed the economics of the recently completed Giant Power Report. Speaking on the so-called giant-power station of 300,000 to 500,000 kw. which it is proposed in the report to establish at the mouth of coal mines in western Pennsylvania and transmit this energy at probably 220,000 volts, throughout Pennsylvania and distribute it through the present electric utility systems, whose generating capacity now installed would be used for stand-by on intermittent service, Mr. Penrose said in part:

"The 'mine-mouth company,' which for brevity we can so designate would engage in the mining of coal and raise from the mines 25,000 tons of coal material per day, for 500,000 kw. capacity; would operate a coal-distillation plant capable of pretreating all the coal mined; would sell the high-grade product for domestic and industrial fuel; and would pulverize the remainder for the production of power. To put it another way, these companies would engage in an industry that would comprise coal mining, power generation, byproduct manufacture and sale, and the wholesaling of all grades of coal not used in any of the operations.

"Upon the assumption of a continued ability to market profitably all these byproducts and residue, is based the nominal charge (25c. per ton) that the report assumes as the cost of fuel delivered in the bunkers at the power house. It is upon this figure that the economies of generation are predicted.

"The proposal which is presented in 'Giant Power' predicates the continued economic existence of the source of base-load power for all of Pennsylvania —upon the continued ability of a group of industrial organizations, the mine-mouth companies, to market profitably the immense quantity of byproducts and residue that will accumulate daily from the mining of 25,000 tons of coal material, for each so-called 'Giant Power' unit. It is not disclosed as to how this quantity of industrial commodity is to be disposed of, even in prosperous times, in competition with long established sources of supply, controlled in part at least by industrial interests in Pennsylvania and elsewhere who have requirement of these commodities which at the present time are secured from plants already established and representing large investment already made.

"Just where the need appears greatest for complete independence from the unavoidable fluctuations of economic conditions in industry, there it is this report proposes the most intimate and indisoluble dependence for power in Pennsylvania upon industrial conditions.

"The report recognizes the necessity for condenser-water supply for the efficient operation of these plants, that the coal resources of the state shall be conserved. In order to secure vacua that will give modern economies in steam turbo-generator operation, American practice requires as much as 400 tons of water to each ton of coal burned. You also know the great difficulty found in locating adequate water supply in proximity to the mines in Pennsylvania. The report proposes that the proverbially small summer flow of these rivers in western Pennsylvania can be increased by flood storage to provide the desired water supply; or, in some locations, that recourse be had to cooling towers. Let us consider each of these two proposals separately, keeping in mind that these stations are 500,000 kw. capacity each.

"I will call attention to the droughts of 1923 and 1924 in California, that resulted in unprecedented scarcity in water storage. The same has been the condition in New England within recent years. Can we consider the stamp of engineering approval given to a proposal that would place the mainspring of the whole of the power supply for Pennsylvania upon flood storage that is dependent upon seasonal variations, and this in a region where water scarcity is a tradition? As to the use of cooling towers, apart from their cost, again can we consider it good engineering to propose to place vital reliance, for tremendous generating capacities, upon what may be considered as wholly untried equipment, so far as American practice is concerned in operation on the scale proposed?

### Limitations of Artificial Cooling

"From the viewpoint of economy in the use of fuel artificial cooling imposes two fundamental limitations. The first is the impossibility within practical limits of securing condensing water at a temperature comparable with that of flowing streams. The second limitation is in the fixed losses due to increased pumping head in the operation of the condensing equipment when artificial cooling is employed. These two factors are entirely apart from any consideration of additional capital investment required for such type of installation.

"Assuming that artificial cooling was practicable on a scale such as proposed for the giant power plants, we must not lose sight of the increased steam consumption due to the moderate vacua that cannot be divorced from artificial cooling, and the effect upon fuel conservation due to the resultant increased consumption of coal. American practice further indicates that the use of circulating water (from stream flow) will procure vacua averaging at least 1½ inches better than can be secured by the use of cooling towers. It is this 1½ inches of vacuum that determines the difference between modern high operating economy and mediocrity. The coal pile knows the difference!

"As to the elimination of all condensing equipment and reliance upon non-condensing operation, which the report touches upon as a possibility, we must analyze the investment costs in boiler capacity and in specially designed large steam turbo-generator units to operate under these conditions, and at the same time we must give regard to some of the practical features of operation. In round figures, we find that for a 500,000-kw. non-condensing plant the boiler capacity and the water rate will be increased 70 per cent over a condensing plant. In the name of conservation, is the additional use of 70 per cent of coal at the mine mouth worth the saving in railroad transportation? In the foregoing a steam rate of 10 lb. per kw.-hr. is taken for condensing operation and 17 lb. for non-condensing.

"Further, assuming 70 per cent increase in steam consumption by a non-condensing plant over a condensing, we

[1]Assistant General Manager Day & Zimmermann, Inc., Engineers, Philadelphia.

have another serious factor that must be given consideration. For a 500,000-kw. plant operating at 60 per cent load factor, the daily loss that is discharged into the atmosphere in the form of exhaust steam would be approximately 60,000 tons of water vapor! This is as much water as a Pennsylvania city of 100,000 population should use! For a non-condensing giant-power plant, this amount would have to be supplied from some source, and treated, in order to maintain operation of the plant! All this in a region where the scarcity of water supply has suggested, in the report, the possibility of using non-condensing operation.

"In the foregoing, so far as it relates to mine-mouth stations, I do not want to be misunderstood or misquoted as opposed to any well-considered proposal looking toward the establishment of mine-mouth generating stations on a scale and under conditions of local demand that could economically fit into the picture in a specific power field, reasonably adjacent to and as a part of a public utility system that could absorb this energy without serious detriment under conditions of depression when the profitable disposal of the by-products and residue from the mine-mouth plant would become a matter of financial embarrassment."

# Hard Steel Turbine Blades Resist Erosion

THE wear of turbine blades may be the result of either erosion due to the impact of solids or fluids or to corrosion, resulting from chemical or similar action exerted by liquids and gases. Frequently, the two types of wear are found together, since one may increase the tendency for destruction by the other.

Steam velocity, wetness of the steam, temperature and blade angle are among the factors that chiefly affect erosion. Tests for determining the relative resistance to erosion of various metals are described in the December, 1924, issue of the *Brown-Boveri Review*, in which steam was projected at comparatively high velocities against materials of square section and also made up into blade sections.

### Test Erosion Greater

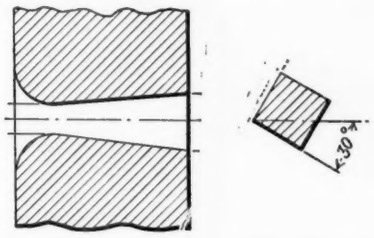
Under these circumstances erosion was much more rapid than that encountered in ordinary practice, but comparative values of the resistances of the various materials were thus quickly obtained. The rapid destruction produced from these tests should not be confused with the much slower rate of wear when a similar action takes place in a steam turbine.

In these erosive tests steam is projected against specimens of square cross-section as shown in the figure and similarly against those made up in blade form. The latter test checks in a general way with the carefully made former test. The tabulations indicate the various materials employed, together with chemical composition, heat treatment, etc. The loss due to erosion in the last column indicates that comparative value of resistance to erosion, referring to the specimen tested in square form.

The square specimen was turned so that one face presented an angle of 30 and another an angle of 60 deg. to the axis of the nozzle. Saturated steam at approximately 140 lb. gage was expanded to 26-in. vacuum, giving a velocity of 3,600 to 4,000 ft.-sec. and a temperature approximating 130 deg. F. Without exception the surfaces inclined at 30 deg. to the axis of the jet were eaten away to a greater extent than those at 60 deg. A definite explanation is not advanced, although the presence of a thin coating of water may have something to do with lessening the impact on the 60-deg. face.

An outstanding result of these tests was the direct bearing on the hardness of the specimen in its resistance to erosion. Specimens $V_4$, $X_1$, $V_2$ and $X_3$ showed great comparative resistance to erosion as in the last column of the tabulation, their hardness being indicated by the heat treatment and also by the Brinell number. The unusually high resistance of specimen $V_5$ is notable. This represents a class of alloy steel composed of chromium and nickel as this analysis indicates. It is unsuitable for turbine blades since this can be worked mechanically only with great difficulty.

The rustless and stainless type of steel such as specimens $V_2$ and $V_4$, withstand the action of nitric acid well, but are rapidly attacked by sulphuric and hydrochloric acids. To the former property in all probability, is due the rustproof properties when exposed to the atmosphere. This valuable property of not corroding in air does not hold necessarily when subjected to a mixture of air and steam. The great loss of weight of brass and Monel metal specimens requires no comment.




*Rectangular specimen* (3.93x3.93 *in. section*) *presents sides at* 30 *and* 60 *deg. to jet axis*

### Solder Washed Out

Tests of the blade forms tended to show in the same way that the harder material resisted erosion better. Where lacing wires were soldered in place, the effect was to wash the solder completely out. This was not due to the temperature of the steam, but to the effect of impact. Hard solder had been used.

Future tests are planned which will take into account other factors entering into erosion such as steam velocity, wetness of steam, temperature, blade angle, etc., so that the bearings of these factors on the subject of blade wear may be better determined.

**Results of Testing by Steam Erosion**

| Material | | Chemical Composition—per cent | | | | | | | | | | | | Loss due to Immersion for 120 hours in 10% Acid Solution | | | | Loss due to Erosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Heat Treatment | Cu | Zn | Ni | Mn | Fe | Cr | Si | S | P | Pb | C | Brinell Number | $H_2SO_4$ | $HNO_3$ | HCl | Total | Duration of Test | Loss in Weight |
| | | | | | | | | | | | | | | Loss of Weight in Ounces | | | | Hours | Grains |
| $V_2$ Rustless chrome steel | | | | 1.49 | 0.32 | | 12.7 | 0.49 | 0.03 | 0.04 | | 0.14 | 232 | 4.85 | 0.04 | 5.94 | 10.87 | 69 | 3.17 |
| $V_4$ Stainless steel | | | | 0.42 | 0.18 | | 11.3 | 0.22 | 0.09 | 0.03 | | 0.33 | 229 | 6.6 | 0.30 | 6.48 | 13.40 | 69 | 2.45 |
| $X_1$ Stainless steel | Heated to 1517° F. and quenched in oil | | | | | | | | | | | | 408 | | Not Determined | | | 68 | 0.56 |
| $V_1$ Special nickel steel | | | | 10.2 | 0.44 | | 0.14 | 0.25 | 0.013 | 0.014 | | 0.15 | 229 | 0.22 | 4.12 | 0.29 | 4.7 | 69 | 6.90 |
| $X_2$ Special nickel steel | Heated to 1517° F. and quenched in oil | | | | | | | | | | | | 338 | - | Not Determined | | | 68 | 1.73 |
| $V_5$ Special chrome-nickel steel | | | | 21.88 | 1.05 | | 2.06 | 1.47 | 0.005 | 0.034 | | 0.72 | 197 | 0.02 | 3.58 | 0.02 | 3.62 | 69 | 0.28 |
| $U_2$ Nickel steel | | | | 7.01 | 0.27 | | | 0.27 | 0.028 | 0.025 | | 0.10 | 163 | 0.13 | 4.10 | 0.15 | 4.38 | 67.5 | 1.50 |
| $X_3$ Nickel steel | Heated to 825° C. and quenched in oil | | | 5.04 | 0.27 | | | 0.22 | 0.034 | 0.014 | | 0.12 | | | Not determined | | | | |
| $W_1$ *Brass (drawn) | | 72.6 | 27.06 | | | 0.15 | | | | | 0.1 | Sn 0.1 | 80 | 1.01 | 3.48 | 0.05 | 4.53 | 71 | 3.48 |
| $W_5$ *Monel metal (drawn) | | 29.17 | 0.3 | 65.3 | 1.64 | 2.9 | | 0.1 | | | | 0.32 | 122 | 0.02 | 0.05 | 0.07 | 0.14 | 71 | 6.90 |

*As specimens of solid section could not be obtained from the material available, a number of pieces of these metals were laid together to make up the required thickness. Therefore, the results obtained are not strictly comparable with the remainder.

# Recent Publications

**Mechanical World, Electrical Pocket Book.** Published by Emmott & Co., Ltd., London, England, 1925. Cloth; 4x6 in.; 326 pages. Price, 40c.

In this little book is contained information on a large variety of electrical subjects, particularly those of interest to practical men. It also contains many tables of useful data. Among the important subjects dealt with are direct-current motor and generator troubles, alternating-current motor and generator troubles, electrical measuring instruments and testing electrical equipment, control and starting equipment for electric motors, storage batteries, etc. Being a British publication, it is quite natural that the work deals with the practice of that country, but since this feature affects details of construction rather than principles, the book should be of interest to all those engaged with practical electrical problems.

**Connecting Induction Motors.** By A. M. Dudley. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City, 1925. Cloth; 6x9 in.; 361 pages; 289 illustrations; 24 tables. Price, $3.

Four years ago, when the first edition of this book made its appearance, it was received with a hearty appreciation by the electrical industry, which it has continued to enjoy. For this reason in the new edition the material of the old is unchanged except for some minor alterations and corrections. The new material has been added in the form of five chapters: Rotor winding; single-phase windings; distribution factor and the uses that are made of it in winding stators of induction motors; connecting to correct magnetic side pull; and lap windings with unequal coil grouping.

This new material, which involves 109 pages, adds considerable to the usefulness of the book and, with the chapters from the old edition, covers in a comprehensive way the subject of reconnecting induction motors for a change in voltage, frequency and the number of phases. In treating of these problems the author reduces all changes to the equivalent of a voltage change, and then by the use of a table the new grouping of the coils that will come nearest meeting the new condition can be read off readily. In addition to the many connection diagrams given throughout the work, one chapter is devoted to winding diagrams, where eighty diagrams are given which show all the possible groupings for two- and three-phase windings from two to fourteen poles.

A problem that is encountered in reconnecting windings is that of unequal coil groupings to obtain a balanced winding as to voltage and phases. A chapter has been devoted to this subject, and the possible groupings of two- and three-phase windings for two to fourteen poles are given in tables and diagrams, so that this information may be easily applied. Another important section is that devoted to locating faults in induction motors. The book is written in a way that will be easily understood by practical men, and this edition merits the same wide circulation as the first had.

**Combustion in the Gas Producer and the Blast Furnace.** By A. Korevaai. Published by D. Van Nostrand Co., New York. Cloth; 5¼x8½ in.; 177 pages. Price, $5.

The author has developed a new theory of combustion in the gas producer and the blast furnace. He shows that in compressing the heat in a furnace a higher temperature is produced with a constant fuel consumption. This means that a definite temperature can be produced with a lower consumption of fuel. He applies this theory to the blast furnace and is, as a consequence, able to explain many heretofore unsolved problems. The volume should be highly illuminating to the blast-furnace engineer.

**"The Annals" on Giant Power**—Electric power supply problems are occupying the public mind as never before. More and more are we becoming dependent upon a reliable supply of cheap power. One has only to consider the number of exhaustive reports that have been made on the power requirements of large areas of the country and how best to supply these needs to be convinced that the question of power supply is one of vital importance to the nation. Not only is this true of our own country but applies equally to all the civilized countries of the World.

The report of the "Giant Power Survey Board of the General Assembly of Pennsylvania," which was issued in February of this year, is a good example of power studies made over large areas. This report, since being made public, has been the subject of much favorable comment as well as adverse criticism. For this reason the report has attracted an unusual amount of attention. "Giant Power Large Scale Electric Development as a Social Factor," has many aspects that must be considered, and it is to these that the March issue of "The Annals" has been devoted. The subject has been divided into: (1) "National Power Programs," which covers the state of power development in Great Britain, France, Germany and Canada. (2) "Rural Electrification," dealing with the needs of and experiences with electricity on the farms and in rural districts. (3) "Labor and Industry," giving the attitude of organized labor and industry toward large-scale power development. (4) "Miscellaneous," going into such questions as the relation of power developments to national defense, financing the developments, the benefits of power in the household, etc. (5) "Technical," in which such questions as load factor, recovery of byproducts from coal, condensing-water supply, are discussed. (6) "Legal," covering some of the questions of legislation and regulation as they apply to so-called giant power. There are in all 31 articles written by leaders in public thought both in this country and in Europe and Canada, dealing with the different questions that enter into any nation-wide movement, such as power development is rapidly becoming. For those interested in these questions this issue of "The Annals" presents many interesting angles, and can be obtained from The American Academy of Political and Social Science, 39th St. and Woodlawn Ave., Philadelphia, Pa. Price, $2 paper, $2.50 cloth.

**Kelvin Centenary Orations and Addresses Commemorative.** Published by Percy Lund Humphries & Co., Ltd., 3 Amen Corner, E.C.4, London, 1924. Cloth; 6x8¾ in. 100 pages. Price 6 shillings net.

An attractive little volume is this, containing as it does the commemorative orations and addresses of the engineering fraternity honoring and recalling the debt they owe to one of their own great, Lord Kelvin, the physicist, on the occasion of the celebration of the centenary of his birth, July 10-11, 1924. It is a welcome addition to the bibliography of Lord Kelvin, as the many sides of his genius are commented upon and some of the intimate conversations had with him are retold by men who had the great good fortune to know him. His many activities both in England and the United States, which he visited in connection with the development of power at Niagara, and where he gave a series of lectures, are related. The Kelvin Oration, by Sir J. J. Thomson, O.M., F.R.S., and tributes presented by the representatives of engineering societies from foreign countries are all included in the volume.

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**Public Service Review, 1924.** The story of the plant equipment of public service operating companies used in supplying electric, gas and local transportation service to the people of New Jersey is interestingly told in a booklet just sent out by the Public Service Corp. of New Jersey. Among other interesting things the booklet pictures in terms of horse and man power the enormous possibilities of the energy made available by the corporation. Descriptions of the plants with brief histories of their origin and progress and pictures of the equipment, together with financial and statistical information, make an attractive review of the corporation's activities and standing.

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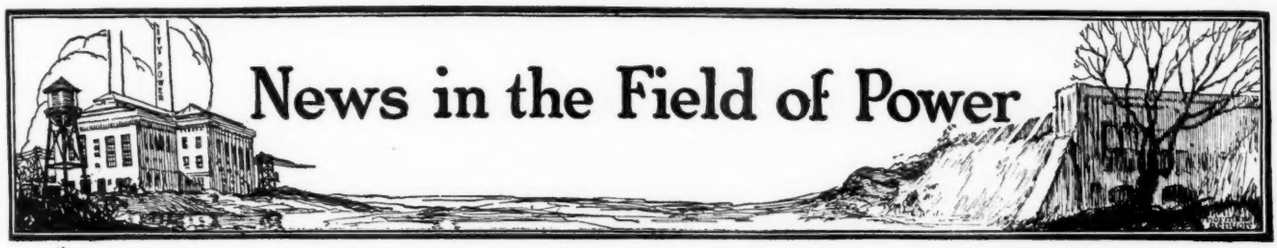
**The Engineering Achievements of the Westinghouse Electric & Manufacturing Co. for the Year 1924,** by H. W. Cope, has recently been issued in pamphlet form. The wide range of manufacturing done by this company and the new problems involved in producing modern equipment are clearly brought out. Stock is taken of what was done during the year. Illustrations of electric locomotives, Diesel tugs, turbines, stokers, etc., record the problems solved and improvements made.




# Merrill, of Federal Water Power Commission, States Views on Interconnection

### Takes Up the Various Angles and Complications of Generation, Transmissiou, Distribution and Sale of Power

AS AN OUTCOME of the discussion of interstate regulation of power which has arisen over the proposed development at Conowingo on the Susquehanna River, O. C. Merrill, the executive secretary of the Federal Power Commission, has expressed the following views:

"Judging from the present trend in power development and distribution, it is a matter of a few years only when high-tension transmission lines will be crossing state boundaries in every direction and we shall have individual, interconnected systems serving areas in several states, even if we do not have a single system covering our whole Northeastern industrial area. Such a result not only is inevitable, but will lead to better service and lower rates, provided there is intelligent public supervision and regulation. The complications that will be involved in the attempt to manage such great properties, if management includes generation, transmission, distribution and sale, will tend to bring about a separation between generation and transmission on the one hand, and distribution and sale on the other. If this happens, the regulation of rates and services will be primarily a regulation of distribution. Service to the consumer is a question of distribution. Probably not less than three-fourths of the cost of service is distribution cost. Distribution then could be required to be performed by corporations organized within the state and rendering service only in a single state. Regulation of generation and transmission, on the other hand, would be primarily a matter of preventing discrimination between different states or between different sections of the same state.

"If the energy developed from hydro and steam plants thus can be turned into a common energy pool, we can take advantage of the economies in operating expense and capital requirements which large-scale production can afford, and we can have energy delivered to the distributing agencies, whether corporate or public, at uniform rates for the same quantity and character of service. I believe such a policy would be preferable to the zoning system followed by the Ontario Commission, whose policy naturally must result in the concentration of industry and of population in those communities where power rates are the lowest. A policy of uniform rates over a large territory would tend to decentralize industry and to avoid the constantly increasing concentration of population in our larger cities.

"Looking forward, as I do, to the development of the power industry along the lines I have outlined, I believe we should adopt state and national policies in harmony with such development and should not place artificial restrictions upon the free interchange of power between states. No one would suggest the necessity or the desirability of permitting a township or a county within a state to recall, at its option, power that may be produced within its borders and was being used in some other township or county. There would be no need of such step because the state has a public service commission that can prevent discrimination between the several counties or townships of the state. The creation of some agency that can prevent discrimination between different states is a wiser social and economic policy than one that would seek to guard the state's interests by placing even a conditional embargo on the export of power. Even if the latter were not a policy of doubtful legality, it would be particularly unwise in most states, since they draw a considerable amount of power from adjacent states. Most states will have to look forward to a constantly increasing dependence on outside sources for their power requirements.

"I am one of those who believe that utility regulation should be left to the states to the full extent of their power, but it is doubtful if the states individually have complete authority in cases of interstate transmission and sale. If they do not have it or cannot secure it, then I believe the United States should act, but only with respect to those matters that are beyond the powers of the states.

"The right to regulate the rates and services of the public-utility corporations of a state is an attribute of state sovereignty, the exercise of which becomes effective to the degree that the states, through appropriate legislation, provide the means for its exercise. The state cannot divest itself of this right, unless perhaps temporarily, by specific contractural or legislative agreement. The same situation exists respecting such powers as the state may exercise through interstate agreements. No rights can be acquired by private interest adverse to these inherent rights of the states to regulate public-service corporations, unless the states by their own action create such adverse rights. If they do, they can abolish them at their option."

## Commerce Department May Get the Bureau of Mines

Transfer of the Bureau of Mines from the Interior Department to the Department of Commerce, by presidential order, it is rumored, is expected to follow the action of President Coolidge on March 19 of transferring the Patent Office to this department.

The Bureau of Mines is a scientific bureau intended as a direct aid to industry and commerce. Its usefulness depends on its ability to cooperate with industry.

## Amends Law Regarding Steam Heating

The New York State Senate passed on March 24 the Fearon bill, which amends the transportation corporation law, Sec. 1, Subdiv. 4, of Sec. 61, Chap. 219 of Laws of 1909, in relation to steam heating powers of certain electrical corporations.

The altered law is briefly: Any corporation, for the purpose of using electricity for light, heat or power in cities other than of the first class, towns, or villages, may have and acquire additional power of supplying steam to consumers from a central station or stations through pipes laid in the public streets, etc.

The amendment would change this act so that any such corporation which had steam heating powers *prior to 1916* may have and exercise such powers *in any city* subject to local authority.

## Arizona Legislature Acts on Colorado Compact

A resolution was adopted by the Arizona Legislature on March 11, which gave the approval of the legislature to the Colorado Compact, conditioned upon the approval by the legislatures of Arizona, California and Nevada, and the Congres of the United States of the "lower division states agreement," as interpreted by the Arizona legislature. This briefly is: That Arizona be apportioned the waters consisting of one million acre-feet per annum, which the Compact apportions to the lower basin, and which is over and above the 7,500,000 acre-feet apportioned in perpetuity to the upper and lower basins. The resolution also provides for a suitable state commission.

According to press reports Governor Hunt has pigeonholed the resolution and has announced his belief that it is illegal and valueless.

## Business, According to Hoover, Is Good

Business in Europe continues to gather momentum. Our own production shows no decreases. Everyone has a job. For these reasons Commerce Secretary Hoover takes no stock in the talk of business recession. Business, he says, always has an attack of nerves when such highly speculative things as wheat and railroad stocks have setbacks. Neither the decline in wheat prices nor the difficulties of the Chicago, Milwaukee & St. Paul have general significance, he believes. Since 85 per cent of the wheat is out of the farmers' hands, wheat price is largely a speculative proposition.

## Reconsiders Heating Plant Plans for St. Louis

On Feb. 14, 1925, the Board of Aldermen of St. Louis, by a vote of 24 to 2, defeated an ordinance which appropriated the sum of $1,000,000 to erect a boiler plant to generate steam at high pressure for heating the buildings, now or about to be erected, on the Plaza at Twelfth and Market Sts.; for the construction of a high-pressure steam line from this plant to the city hospital group, a mile distant, and the purchase of all power from a local utility company. The action is the latest development in a long discussion and series of hearings among the engineers of the Department of Public Utilities of the City of St. Louis, an engineer employed by the Citizens Supervisory Bond Issue Committee, who advocated the high-pressure steam plant and the purchase of power, and engineers employed by the Joint Board of Engineers Associations who advocated the generation of power and the use of exhaust steam for heating.

As part of a total issue of $87,000,000 to be devoted to public improvements, the citizens of St. Louis voted as "Proposition 11, the sum of $1,000,000 for the erection of a combined plant and the installation therein of equipment to provide light, heat and power for municipal buildings and the installation therein of a machine shop, a garage and a laundry for municipal requirements." It was the general understanding among the citizens that it was the intention to erect a complete power plant, generating both steam and electricity.

Shortly after the bond issue election the Department of Public Utilities issued a report in which was advocated the erection of a steam plant at the Plaza site, the generation of steam at 175 lb. pressure for heating the Plaza group, reducing the pressure by a combination of small lines and reducing valves, the closing down of the present isolated plant at the city hospital and the construction of a 5,300-ft. line to this institution, power to be purchased from the central station. This plan was changed by the department engineers in a supplementary report and the generation of power advocated for the hospital, taking the steam from the underground line and using the exhaust as at present.

The Joint Board of Engineers' Associations, an organization composed of stationary and operating engineers, retained a consulting engineer to investigate and report upon the situation. The Citizens Supervisory Bond Issue Committee also employed an engineer to investigate and report to them.

After investigating, the engineers' representatives reported at a public hearing before the Public Utilities Committee of the Board of Aldermen, that they did not agree with the report of the department engineers, that the most economical plan would be to retain the hospital plant as at present, spending a nominal sum for improvements there, and to build at the Plaza site a power plant that will generate both steam and electricity, using the exhaust steam for heating. A report was presented to substantiate these suggestions. The aldermen laid the matter over until a later date. The next move was a hearing before the subcommittee on Proposition 11, of the Supervisory Committee, at which both sides presented their case. As a result of the hearing, this committee voted 3 to 1 to advise the Board of Aldermen to kill the bill as presented. The one member in favor of the bill presented a minority report.

The Supervisory Committee asked that the matter be presented at a meeting of the entire committee. This was done and after a hearing the minority report was adopted and the committee reported to the aldermen as favoring the bill as written. The Public Utilities Committee of the aldermen then announced another public hearing on the bill, at which both sides presented their cases.

### Points Brought Out at the Hearings

Some of the salient points brought out at that hearing were, that the D.P.U. engineers used incorrect figures in estimating the cost of coal for the various institutions, that they had mixed the cost of coal and electricity so that the comparisons were not true; that the proposed steam line to the city hospital would not be reliable enough for an institution of that character, if constructed according to the method proposed, and if constructed so as to make it reliable, the cost would be prohibitive; that the hospital plant never had been shut down in twenty years, whereas hospitals purchasing energy were without power at frequent intervals, enough to be viewed with some alarm; that the labor cost would be practically the same whether power was generated or not, that exhaust steam was as effective as live steam for heating, and the additional cost of the savings effected by the use of the exhaust, and that the power plant at the city hospitals was a self-supporting institution and should be operated as an isolated plant. This plant uses six times as much low-pressure steam as is produced by the generation of electricity. High-pressure steam also is needed, whether electricity is generated or not.

The committee, after consideration, then voted 7 to 1 to report the bill for defeat.

James A. Hooke, Director of Public Utilities; Kurt Toensfeldt, engineer in the department; John J. Lichter, engineer to the Supervisory Committee, presented the original reports and arguments, advising for the making of high-pressure steam for heating and the purchase of power. The Larkin Engineering Co., represented by David Larkin and J. N. Junkins, made the report and investigations for the Joint Board of Engineers' Associations, which resulted in the defeat of the bill as presented. A new bill will be prepared that will provide for the installation of equipment to generate light, heat and power.

## New York Public Utilities May Change Hands

According to the *New York Times* of March 26, one of the largest New York State public-utility transactions in several years has been practically concluded between the estate of Anthony N. Brady and the Power Corporation of New York. It is stated that the properties involved are the Utica Gas & Electric Co., the Municipal Gas Co., of the City of Albany, the Cohoes Power & Light Corp. and the Troy Gas Co.

The Power Corporation of New York's system embraces the Power Corporation as the holding company and the Northern New York Utilities, Inc., a subsidiary, whose operating lines extend from Niagara and the St. Lawrence River down to Rome, N. Y., in the Mohawk Valley and within a short distance of Utica. Through the Northern New York Utilities, Inc., the Power Corporation is a major unit in the distribution of hydro-electric energy to New York State communities. It is in the Rochester-Albany and Buffalo-Niagara sections of the state, as well as in the system's own territory, that the great future market for the system's output of power is said to be.

## Institute of Refractories To Be Organized

Tentative plans have been announced for the organization of "The American Refractories Institute," one of the main purposes of which will be to provide a satisfactory means for contact between representatives from all industries that use and manufacture refractories, in order that their various economic and technical problems with respect to heat-resisting materials may be thoroughly considered and efforts made to solve these problems.

According to the announcement it is proposed to maintain a research laboratory where outstanding problems will be studied.

The organizing committee is now inviting the attention of men who use refractories that the Institute may act as a service bureau for consumers as well as for producers of refractories. Membership dues will be nominal.

A meeting is to be held in Pittsburgh, Pa., April 14, when final plans for incorporation will be discussed. Representatives from industrial firms that use refractories are invited to attend this meeting.

Macdonald C. Booze, Mellon Institute of Industrial Research, Pittsburgh, is temporary secretary and will be glad to furnish details of the coming meeting.

## Sandwich Fuel Bed Advocated

In a paper on "Fuel Economy," read recently before the Institute of Marine Engineers (England), according to *The Engineer*, E. W. L. Nicol said that by using a mixture of coal and coke on the sandwich system for firing a boiler, considerable economy had been effected. On the sandwich system the coke is fed on to a chain-grate stoker as a thin layer, and the coal is spread as another layer above.

## New York Political Water Power Activities

On March 19 Governor Smith sent a special message to the Legislature in which he expressed his objection to permitting the control and ownership of power resources passing out of the hands of the people of the state. He urged the immediate consideration of the subject of the natural water-power resources of the state which are going to waste and which would be capable of generating power for use in the homes and industries of the state.

The Wales-Hutchinson bill, introduced in the Senate and Assembly March 11, entitled "An Act To Authorize the Water Power Commission of the State to negotiate with other states, the District of Columbia and Canadian provinces, compacts under the Constitution of the United States for action by the Legislature for the regulation of interstate and foreign transmission and delivery of electric current," has been reported out of committee and placed on the respective calendars of the two houses and will probably be passed. The bill is drawn in the Pennsylvania form and reads:

"Sec. 1. That the Water Power Commission is hereby authorized to negotiate from time to time with any state of the Union, including the District of Columbia, and any Canadian province, or with any number of such states and provinces compacts in accordance with the Constitution of the United States for adoption or rejection by the legislature of this state for the purpose of regulating interstate or international or both, transmission and sale or delivery of electric current for use in public service upon principles of mutability, equality, justice and efficiency. Every compact so negotiated shall be submitted by the water power commission to the legislature and the Congress of the United States having consented thereto, shall be in full force and effect upon its ratification by a duly enacted law of this state, and by the other parties thereto as their laws severally may prescribe."

This measure is introduced in furtherance of, and co-operation with, the hydro-electrical development program of Governor Pinchot of Pennsylvania, and has in mind the intra-state regulation of a superpower development between the Canadian provinces and the Eastern border states. If enacted by all the states affected, it will form a basis not only for regulation of interstate development of state-owned power, but for the interstate development of a super-hydro-electric system which is rapidly being consummated by private corporations.

## John Frank Stevens Receives John Fritz Medal

The John Fritz Medal, one of the highest awards of the engineering profession, was presented to John Frank Stevens, at the Engineering Societies Bldg., 29 West 39th St., New York City, March 23.

John R. Freeman, dean of American engineering and former president of the American Society of Civil Engineers, presided. The medal was formally bestowed on Mr. Stevens before a large audience by Charles F. Rand, chairman of the board of awards, after Ralph Budd, president of the Great Northern Railway Co., and Roland S. Morris, former United States Ambassador to Japan, had spoken of his great contribution through engineering to the advancement of civilization.

Mr. Budd told of Mr. Stevens' skill and fortitude in finding Manas Pass in

Courtesy N. Y. World

*John Frank Stevens*

the Rocky Mountains and of his genius in planning the task of building the Panama Canal. Stressing the infinite amount of detail that had to be worked out in advance, the speaker showed that the brain of the engineer provided for each so precisely that the project reached completion with perfect success.

Roland S. Morris told how Mr. Stevens and a band of railroad men operated the crippled railroads in Siberia and Eastern China and kept open the back door to Russia, by which means the Czech army completed its journey around the world to re-enter the war on the western front.

Mr. Stevens modestly disclaimed any personal triumphs, attributing his success to the men who had worked with him. "There is not a man who ever worked for me whom I cannot now call my friend. That is my greatest triumph," he said. He traced briefly his career, from his start in Maine when he did not know even the meaning of a "technical training," through the pioneer work in locating railroads in the West, to the Panama Canal and then to Siberia, studying engineering all the time by observing the work of those who had gone before him.

## Boulder Canyon Hearings To Be Held in Los Angeles

Owing to the fact that several members of the Senate Committee on Irrigation and Reclamation are planning European trips during the summer, it will not be possible for the committee to undertake its field hearings until fall. It will assemble in Los Angeles Oct. 26 to take testimony in connection with the proposed development at Boulder Canyon on the Colorado River. Following that hearing the committee will proceed to Boulder Canyon so that its members may visualize the location. It will make a trip up the river as far as Glen Canyon. Hearings will also be held in Lasvages and Yuma.

## Power Survey for South Asked of Hoover

Representatives from seven state utilities commissions in the Southeastern States, meeting in Atlanta recently, adopted a resolution inviting Secretary Hoover of the Department of Commerce to initiate a superpower survey for the states of Virginia, Kentucky, Tennessee, North and South Carolina, Florida, Georgia, Alabama, Mississippi and Louisiana.

This survey, which was asked in a resolution prepared by McGregor Smith, engineer of the Tennessee Railroad and Public Utilities Commission, would include a study of hydro-electricity and steam-generated electricity with a thorough research into economic problems, such as transmission costs and similar questions.

## Statement Made in Regard to G. E. Investigation

Such attention as is being given at this time by the Federal Trade Commission to the investigation of the General Electric Co. is being concentrated on a review of existing literature dealing with the matter. No questionnaires have been sent out as yet and no plans for the gathering of information have been formulated. The commission has issued the following statement as to the status of the investigation:

"On Feb. 9, 1925, the Senate directed the commission to investigate and report to the Senate to what extent the General Electric Co. directly or indirectly, through the stockholders or otherwise, controlled the generation and transmission of electric power, how the said control was acquired and maintained, and what effort, if any, had been made by it or by others in its behalf to influence public opinion on the question of public ownership in the electric power industry. Work on this inquiry was promptly initiated."

Publication of a statement that the Federal Trade Commission may not attempt to investigate the General Electric Co. as a result of the Supreme Court's decision in the Baltimore grain cases, which held the commission to be without authority to seize or search the books of a private corporation in the conduct of a general investigation, brought from the commission, on March 25, a pronouncement to the effect that no action had been taken to halt

the investigation which already is under way. The General Electric Co., it is said, will raise no questions as to its rights and will furnish voluntarily any information necessary.

## Export Duty on Canadian Hydro-Electric Power

Under an order in council effective from April 1, export duty of three one-hundredths of one cent per kilowatt-hour has been imposed upon hydro-electric power, according to a cablegram just received from Trade Commissioner Lynn W. Meekins, at Ottawa. This is equivalent to $1.95 per horsepower-year.

## American Oil-Engine Builder Sells European License

Many of the American builders of oil engines are operating under a license from a European company. However, a reversal of this tendency is to be seen in the action of Carels of Belgium, one of the largest builders of air-injection Diesel engines, in purchasing a license to manufacture the Price solid-injection oil engine from the Ingersoll-Rand Co., of New York.

## St. Lawrence Plan Awaits Diplomatic Interchanges

While the allotment of this summer's field work on the St. Lawrence cannot be made until the Joint Engineering Board can meet, the American members of the Board have in readiness a tentative plan covering the field work that they probably will be called upon to do. Unless there should be some unexpected delay in the diplomatic interchanges that are in progress, the probabilities are that field work can begin as soon as the river is free of ice.

The American engineers already have drawn up specifications for the contract borings. Immediately following the meeting with the Canadian engineers they will let emergency contracts, which will enable them to take full advantage of the rather short season during which the work can be carried on to advantage.

## Joint International Water Boundary Board Meets

The members of the Joint International Commission on Boundary Waters, opened a hearing on March 25 on the application of New Brunswick to the Dominion government for permission to develop Grand Falls on the St. Johns River at Van Buren, Me. The members of this commission are: American — Former Senator Clarence D. Clark, of Wyoming, chairman; former Senator Fred T. Dubois of Idaho; William H. Smith, secretary; and George W. Reik, reporter. Canadian—Charles A. Magrath, chairman; Sir William H. Hearst, H. A. Powell, K. C., and Lawrence J. Burpee. Delegations and representatives of interested towns, power companies, railroads and the State of Maine were also present. The hearings will occupy several days, according to press reports.

## Board for Arbitration Study Authorized

A conference on commercial arbitration, which was attended by a large and diversified group of leaders in social, industrial and political life, was held recently at the home of Mrs. Vincent Astor in New York City. Resolutions were adopted calling for a Conference Board for continuous study of commercial arbitration and concilation and also for the exchange of information with a view to the co-ordination of arbitral tribunals and methods.

It was conceded by the various speakers that everywhere arbitration was gaining ground and that business and individuals now seem to be actively engaged in the actual practice of arbitration. It was stated that the congestion in the courts was very great, that the New York Supreme Court's trial calendars contain more than 27,000 untried cases. Similar congestion prevails in the Federal courts, it was reported.

## The Awakening Giant

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## Importance of River Surveys To Be Shown

To comply with the provisions of the new River and Harbor Act the Corps of Engineers and the Federal Trade Commission are gathering data as to the cost of a comprehensive survey of the rivers of the country and information that is expected to establish, as never before, the need for such a study.

The survey is urgently needed so that power development, navigation improvements and flood control can be carried forward in the most effective fashion.

The Federal Power Commission will confine its work to material that will bring out clearly the need for a nation-wide survey of rivers and streams. Because of lack of engineering data the Power Commission now is compelled to give rights for fifty years without knowing whether the proposed power development will fit into the maximum utilization of the stream's resources or the plan best calculated to aid flood control and navigation.

## President Coolidge Names Muscle Shoals Board

President Coolidge named on March 27, "to examine into and report to him upon the most practical method or methods of utilizing to the best advantage the Muscle Shoals facilities," the following commission: Former Representative John C. McKenzie, of Illinois; former Senator Nathaniel B. Dial of South Carolina; Prof. Harry A. Curtis, of Yale University, and the Department of Commerce; William McLellan, of New York; and Russell F. Bower, of the American Farm Bureau direction.

## Prizes for Power Industry Reviews and Forecasts

Prizes aggregating $10,000 have been offered by Bonbright & Co., Inc., for the best contemporary review and forecast of the electric light and power industry, to be written in the form of an article summarizing the progress of the decade 1920-1930 and dated as of Jan. 1, 1930. It will thus be in effect a five years' review and a five years' forecast. The directors of the American Superpower Corporation will act as judges and in addition have authorized another prize of $10,000 in the name of the corporation to be awarded to that contestant whose paper, reviewed again in 1930, shall appear to have most nearly approximated the facts as they eventuate. This prize will be awarded as soon after Jan. 1, 1930, as is possible.

The Bonbright award will consist of a first prize of $5,000, a second prize of $1,000, a third prize of $500, ten prizes of $250 each and ten prizes of $100. The articles must be submitted to Bonbright & Co. on or before May 18 and are subject to the following regulations: They must be in the English language, typewritten and submitted on plain white paper and be confined within the limits of five thousand to ten thousand words. Every article is to be signed with a fictitious name accompanied by a sealed envelope containing both the pseudonym and the contestant's real name and address. The article submitted may be a collaboration of two or more authors. The prize will then be divided equally among the authors. No single competitor, may submit more than one article. The article may be accompanied by charts, diagrams, etc., but such additional material is in no sense obligatory. The articles are to comprehend the development of the industry in all its phases, including public relations, finance, markets, transmission and distribution of electrical energy.

A Data Book, containing the most generally accepted facts on the industry, can be obtained free of charge, from Van H. Cartmell, Bonbright & Co., Inc., 25 Nassau St., New York City.

If possible, the prize winners will be announced at the National Electric Light Association convention in San Francisco during the third week of June. All manuscripts will be preserved and again submitted for judgment on Jan. 1, 1930, and the announcement of the winner of the additional prize of $10,000 will be made as soon thereafter as possible.

## Personal Mention

**Charles E. Lucke,** professor of mechanical engineering, Columbia University, has been retained by the Babcock & Wilcox Co., 85 Liberty St., as consultant.

**James Hartness,** former Governor of Vermont and president of the American Engineering Council, is seriously ill in Boston, having undergone two operations since Feb. 26. He is expected to recover, however.

**Clarence Herbert Sanderson,** of the engineering staff of the New York Edison Co., has been appointed assistant electrical engineer, succeeding **R. H. Tapscott,** who has assumed the duties of electrical engineer.

## Society Affairs

**The Allentown (Pa) Section of the A.S.M.E.** will have as the subject for its April 3 meeting "Storage and Handling of Coal," by H. E. Boughton, Trojan Powder Co.

**The Cleveland Section of the A. I. & S. E. E.** will have as the topic for its April 11 meeting, "Electric Power Generation by Blast Furnace Plant," by O. C. Callow, Trumbull-Cliffs Furnace Co., Warren, Ohio.

**The Chicago Section of the A.I. & S.E.E.** will hold a meeting on April 8. The subject will be "Interesting and Special Applications of Auxiliary Motors and Control in Steel Mills," by P. J. McShane, Westinghouse Electric & Manufacturing Company.

**The Institution of Naval Architects,** 5 Adelphi Terrace, London, W.C.2, will hold its 1925 session, April 1-3. Papers of interest to *Power* readers are: "Relative Commercial Efficiency of Internal Combustion and Steam Engines for High-Speed Passenger Vessels," by Sir John H. Biles; "Analysis of Prof. Sir John H. Biles's Paper on H.M.S. 'Wolf' Experiments," by G. H. Hoffman, Esq., of Delft University; "Stresses in Rectangular Plates Clamped at Their Edges and Loaded with a Uniformly Distributed Pressure," by Prof. C. E. Inglis; "Second Report of the Marine Oil Engine Trials Committee."

## Business Notes

**The Chicago Pneumatic Tool Co.,** Chicago, Ill., announces the opening of a branch office at Apartado 695, San Juan de Letran, 15 Mexico City, D.F.

**The Trico Fuse Manufacturing Co.,** Milwaukee, Wis., announces the addition to its staff of William T. Clark, who will devote most of his time to users of "Kantark" its non-renewable fuse.

**The Marion Machine Foundry & Supply Co.,** Marion, Ind., announces that: A. G. Hill, 45 Jarvis St., Toronto, Ont., has the agency for the Marion stoker in Toronto; the Riley Engineering & Supply Co., 7360 Dufferin St., Toronto, Ont., has been appointed exclusive agents for the Marion soot blowers in Canada.

## Coming Conventions

**American Association of Oil Burner Manufacturers.** Leod D. Becker, Bank of Galesburg Bldg., Galesburg, Ill. Convention and exhibit at Edgewater Beach Hotel, Chicago, April 1-3.

**American Chemical Society.** Dr. Chas. L. Parsons, Mills Bldg., Washington, D. C. Meeting at Baltimore, April 6-10.

**American Electrochemical Society.** Dr. Colin G. Fink, Columbia University, New York City. Convention at Niagara Falls, April 23-25.

**American Institute of Electrical Engineers.** F. L. Hutchinson, 29 West 39th St., New York City. Convention at St. Louis, April 13-17. Annual convention at Saratoga Springs, June 22-26.

**American Society of Civil Engineers.** George T. Seabury, 29 West 39th St., New York City. Spring meeting in Cincinnati, April 22-24.

**American Society of Mechanical Engineers**—Calvin W. Rice, 29 West 39th St., New York City. Spring meeting at Milwaukee, Wis., May 18-21.

**American Water Works Association.** W. N. Niesley, 170 Broadway, New York City. Convention at Louisville, Apr. 27-May 3.

**Eastern Ice Association**—William H. Ross, 35 Warren St., New York City. Fourth Spring meeting at Fort Pitt Hotel, Pittsburgh, Pa., on March 31-April 1.

**Exposition of Inventions**—American Institute, E. W. Bartlett, 47 West 34th St., New York City. Exposition at Engineering Societies Bldg., 29 West 39th St., New York City, April 27 to May 2.

**Master Boiler Makers Association.** H. D. Vought, 26 Cortlandt St., New York City. Convention at Chicago, May 19-22.

**Mid-West Power Show** at Milwaukee, Wis., May 18-21. Ralph H. Cahill, care of Mid-West Power Show, City Hall, Milwaukee, Wis.

**National Association of Stationary Engineers.** F. W. Raven, 417 South Dearborn St., Chicago, Ill. National convention and exhibition at St. Paul, Minn., Aug. 31-Sept. 4. Annual conventions and exhibitions of state associations are scheduled as follows: **Indiana State Association** at Purdue University, Lafayette, Ind., April 20-23. W. C. Knowles, Northern Indiana Gas & Electric Co., Lafayette, Ind. **Kansas Association** at Topeka, May 6-8. J. M. Van Sant 739 Horne St., Topeka. **Pennsylvania Association** at Pittsburgh, Pa., May 15-16. Frank J. McCarron, 3647 North 11th St., Philadelphia, Pa. **Wisconsin Association** at Milwaukee, May 18-22. F. W. Horn, 256 29th St., Milwaukee, Wis. **New Jersey Association** at Atlantic City, June 4-8. H. W. Vail, 1244 Park Ave., Plainfield, N. J. **New York Association** at New York City, June 11-13, W. T. Meinzer, 3rd St., near Warburton, Bayside, L. I. **Iowa State Association** at Ottumwa, June 16-18. F. L. Stocker, 127 S. Elm St., Ottumwa, Iowa. **New England States Association** at Worcester, Mass., July 10-12, formerly announced June 18-20. F. L. Tyler, 32 Briggs St., Taunton, Mass. **Ohio Association** at Middleton, Ohio, June 18-20. T. S. Garrett, 2622 East Second St., Dayton, Ohio. **Connecticut Association** at New Haven, June 25-27. George F. Klopfer, 30 East Pearl St., New Haven. **Michigan Association at Muskegon,** July 15-17. Charles Unterreiner, 5522 Underwood Ave., Detroit, Mich. **Minnesota Association** at St. Paul, Aug. 24-28. C. A. Nelson, 800 22nd Ave., Minneapolis, Minn.

**National District Heating Association.** D. L. Gaskell, Greenville, Ohio. Sixteenth annual convention at West Baden Springs Hotel, West Baden, Ind., May 19-22.

**National Electric Light Association.** M. H. Aylesworth, 29 West 39th St., New York City. Annual convention at San Francisco, June 15-20.

## Trade Catalogs

**Hoists**—American Hoist & Derrick Co., St. Paul, Minn. Catalog No. 110 is a 142-page presentation of the company's hoists, derricks, engines and other equipment. It is well illustrated and contains many tables of dimensions and capacities.

**Soot Blowers** — Marion Machine, Foundry & Supply Co., Marion, Ind. Catalog No. 50-R describes with many illustrations these soot blowers and their application to the various makes of boilers and economizers as well as their construction and installation.

**Load Indicators, Central Station,** Chas. Cory & Sons, Inc., 183 Varick St., New York City. Catalog Bulletin No. 104-29-B describes station load indicator No. B-871; single-face alternating-current load indicator No. B-959; load indicator B-871, with period light indicator and time clock; load dispatcher's indicator No. B-690.

## Fuel Prices

### COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; *mine run* except Pittsburgh gas slack (*Coal Age*):

| **Bituminous,** Net Tons | Market Quoting | Mar. 23, 1925 |
|---|---|---|
| Pool 1 | New York | $2.50@$2.85 |
| Smokeless | Boston | 1.66 |
| Clearfield | Boston | 1.75@ 2.20 |
| Somerset | Boston | 1.90@ 2.35 |
| Kanawha | Columbus | 1.40@ 1.60 |
| Hocking | Columbus | 1.35@ 1.60 |
| Pittsburgh | Pittsburgh | 1.75@ 1.90 |
| Pittsburgh gas slack | Pittsburgh | 1.30@ 1.40 |
| Franklin, Ill. | Chicago | 2.25@ 2.50 |
| Central, Ill. | Chicago | 2.15@ 2.25 |
| Ind. 4th Vein | Chicago | 2.25@ 2.50 |
| West Ky. | Louisville | 1.25@ 1.50 |
| S. E. Ky. | Louisville | 1.25@ 1.50 |
| Big Seam | Birmingham | 1.50@ 2.00 |
| **Anthracite,** Gross Tons | | |
| Buckwheat No. 1. | New York | $2.00@$3.00 |
| Buckwheat No. 1. | Philadelphia | 2.25@ 3.00 |
| Birdseye | New York | 1.40@ 1.60 |

### FUEL OIL

**New York**—Mar. 26, light oil, tank-car lots; 28@34 deg. Baumé, 6½c. per gal.; 36@40 deg., 6¾c. per gal., f.o.b. Bayonne, N. J.

**St. Louis** — Mar. 25, tank-car lots, f.o.b St Louis; 24@26 deg., $1.90 per bbl.; 26@28 deg., $1.95 per bbl.; 28@30 deg., $2.00 per bbl.; 30@32 deg., $2.05 per bbl.; 32@36 deg., gas oil. 5½c. per gal.; 38@40 deg.. 6c. per gal.

**Pittsburgh**—Mar. 16, f.o.b. local refinery; 30@34 deg. fuel oil, 6¾c. per gal.; 36@40 deg., fuel oil, 7c. per gal.

**Dallas**—Mar. 23, f.o.b. local refinery, 26@30 deg., $1.90 per bbl.

**Philadelphia**—Mar. 25, 28@30 deg., $2.52@$2.583 per bbl.; 18@22 deg., $2.42@$2.483; 13@16 deg., $2.20½@ $2.268 per bbl.

**Boston**—Mar. 23, tank-car lots, f.o.b. heavy oil, 12@14 deg., Baumé, 4¾c. per gal.; light oil, 28@32 deg. Baumé, 6c. per gal.

**Cincinnati** — Mar. 24, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c per gal.

# New Plant Construction

**Calif., Victorville**—Appleton Land, Water and Power Co., 604 Washington Bldg., Los Angeles, is having plans prepared for the construction of dam and conduit to generate electric power, developing 2,000 hp. to operate pumps for the irrigation of 20,000 acres, here. H. Hawgood, H. W. Hellman Bldg., Los Angeles, is engineer.

**D. C., Washington**—U. S. Government has granted appropriation and is having plans prepared for power plant improvements, including new stokers. Estimated cost $251,800. D. Lynn is Capitol Building architect.

**Ill., Oquawka**—City will receive bids in March for waterworks improvements, including pumping equipment, reservoir, etc. Estimated cost $20,000. Caldwell Engineering Co., 502 Ayres Bank Bldg., Jacksonville, Ill., is engineer.

**Ill., Venice**—City plans the construction of a sewer system, including pumping plant, etc. Estimated cost $200,000. Shepard & Morgan, Edwardsville, are engineers.

**Ind., Indianapolis**—E. G. Spink, Hume Mansur Bldg., plans the construction of an 8 story hotel building with 250-car garage, on Meridan St., here. Estimated cost $3,500,000. Private plans.

**Ia., Cedar Rapids** — Iowa Railway & Light Co., W. G. Dows, Dows Bldg., is having plans prepared for the construction of a 14 story, store and office building at 2nd Ave. and 2nd St. Estimated cost $1,000,000. Childs & Smith, 720 North Michigan Ave., are architects.

**Kan., Haviland**—City will hold an election April 7, to vote $60,000 bonds for the construction of a waterworks system, including pumping equipment, etc. E. T. Archer & Co., New England Bldg., Kansas City is engineer.

**Kan., Kansas City**—G. C. Newland, 29 South 18th St., awarded contract for the construction of an ice plant, here, to Rand & Miller, 619 Elks Bldg. Estimated cost $100,000.

**Kan., Seneca**—City, J. T. Campbell, Clk., plans the construction of a waterworks system, including pumping equipment, etc. Estimated cost $20,000. Engineer not selected.

**La., Bossier City**—Town Council, will receive bids until April 8 for the construction of waterworks, improvements, including air compressor and motor, 125 g.p.m. centrifugal pump and motor, pumping building, etc. E. T. Archer & Co., Shreveport, are engineers.

**La., Shreveport**—Independent Ice Co. awarded contract for the construction of an ice plant to Hansen-Worden Co. on cost plus basis. Estimated cost $40,000.

**Md., Baltimore**—Standard Electric Machinery Co., 9 East Hill St., is in the market for one 75 hp. hoist motor, 3-25-440 with revolving drum and grids for regulating duty, with or without brake; 25 to 50 k.w. 230 v. engine set; 6 to 8 ton compressor ice machine with tanks and cans.

**Mass., Boston**—City, City Auditor, City Hall, will receive bids until April 10, for the construction of a 9 story, hospital, at Albany and East Concord Sts. Estimated cost $750,000. Ritchie, Parsons & Taylor, 15 Ashburton Pl., Boston, are architects.

**Mass., Boston**—Trustees of Public Library will receive bids until April 1, for the furnishing and installing a steam engine and electric generator, including necessary materials and labor in the Boston Public Library, Copley Sq. L. E. Kirstein, is president.

**Mass., Worcester**—Commonwealth Ice Co. plans the construction of an ice plant, to replace fire loss. Estimated cost $50,000. Architect not selected.

**Mich., Detroit**—Book Estate, Book Bldg., Washington Blvd., plans the construction of a 35 story, office building, with steam heating system, and complete electrical equipment, including elevators, at Washington Blvd. and Grand River St. Estimated cost $3,000,000. Architect's name withheld.

**Mich., Detroit** — Ernst Kern Co., 1030 Woodward Ave., is having preliminary plans prepared for the construction of a 10 story mercantile building, including electric elevators and steam heating system, on Woodward Ave. Smith, Hinchman & Grylls, 800 Marquette Ave., are architects.

**Mich., Detroit** — Janke, Verman & Krecke, 612 Broadway Central Bldg., Archts., will receive bids about April 1st, for the construction of an 11 story apartment, including electric elevators, steam heating system, etc., at Parker and Agnew Aves., for the Chippewa Apartment Co., 1130 Parker Ave.

**Mo., Leeper**—Black River Power and Development Co., c/o W. H. Meredith, Poplar Bluff, recently incorporated, has had preliminary plans prepared for the construction of a power plant and dam on the Black River near here. Estimated cost $3,500,000. R. I. Randolph, 38 South Dearborn St., Chicago, Ill., is engineer.

**Mo., North Kansas City**—Wabash Railway Co., Exchange Bldg., St. Louis, is having plans prepared for improvements, including icing plant. Estimated total cost $200,000. R. H. Howard, Railway Exchange Bldg., St. Louis, is engineer.

**Mo., St. Louis**—Bd. of Public Service, 308 City Hall, is receiving bids for the refrigerating equipment, coils, etc., for the Robert Koch Hospital, Koch. Estimated cost $32,000. L. R. Bowen & H. Updike, 301 City Hall, are engineers.

**Mo., St. Louis**—S. Koplar, 5859 Waterman Ave., awarded contracts for the construction of an 8 story apartment at Union Blvd. and Washington St., to P. J. Bradshaw, International Life Bldg., Archt., who will supervise construction and act as general contractor. Estimated cost $1,000,000.

**Mo., St. Louis** — Local Syndicate, c/o Wenzlick Realty Co., 1010 Chestnut St., is having preliminary plans prepared for the construction of a 12 story, office building at Chestnut and 11th Sts. Estimated cost $1,000,000. Private plans.

**Neb., Bennett**—City is having preliminary plans prepared for the construction of a waterworks system, including deep well, pumps, etc. Estimated cost $18,000. Hollister Engineering Co., Banker Life Bldg., Lincoln, is engineer.

**N. J., Trenton**—City Commission, L. D. Hirsch, Clk., will receive bids until April 10 for the construction of a sewage treatment works, including pumping equipment, motors, etc. G. A. Johnson & G. L. Watson, 150 Nassau St., are engineers.

**N. Y., New York**—550-Fifth Ave. Corp., c/o G. Keister, 56 West 45th St., will build a 16-story office building, including steam heating system, at 556 Fifth Ave., by day labor.

**N. C., Andrews**—State legislature has authorized $50,000 bond issue, for completion of electric light plant.

**N. C., Brevard**—Cascade Power & Light Co., E. S. English, Pres., plans to double the capacity of 1,500 hp. plant on Little River, here. Additional equipment will be required.

**O., Cleveland**—The Ohio Bell Telephone Co., 4300 Euclid Ave., C. P. Cooper, Pres., awarded contract for the construction of the foundation of a 31 story telephone exchange and office building at East 8th St. and Huron Rd. to Lundoff Bicknell Co., B. F. Keith Bldg. Estimated cost $7,500,000. Hubbell & Benes, 4500 Euclid Ave., are architects.

**O., Cincinnati**—Chamber of Commerce, 126 East 4th St., plans the construction of a 10 story chamber of commerce building, at 4th and Sycamore St. Estimated cost $1,000,000. H. Hake, Telephone Bldg., is architect.

**Okla., Blanchard**—City plans an election April 7th to vote $35,000 bonds for the construction of a waterworks system, including pump house, pumps, etc. Gaut Baker Co., 1116 West Main St., Oklahoma City, is engineer.

**Okla., Idabel**—City, voted $23,000 bonds for motor driven pumps, 100 hp. oil engine, generator set, etc. V. V. Long & Co., Oklahoma City, is engineer.

**Okla., Idabel**—G. H. Ethridge, is in the market for 200 hp. oil engine and shaft equipment for gin and compress. Estimated cost $10,000. G. Dean, is engineer.

**Okla., Oklahoma City**—New State Ice Co., 2 West Third St., awarded contract for the construction of an ice plant, on Poplar St., to Campbell & Price, 605½ West Main St. Estimated cost $100,000.

**Ore., Portland**—L. A. Phillips, Pacific Life Insurance Bldg., Los Angeles, Calif., plans the construction of a hotel at 5th, 6th, Taylor and Salmon Sts., here. Estimated cost $2,000,000. Architect and engineer not announced.

**Pa., Philadelphia**—W. Webster, 366 Madison Ave., New York City, awarded contract for the construction of an 18 story apartment house, at 17th and Locust Sts., here, to Barras Construction Co., 1612 Market St. Estimated cost $2,500,000.

**Pa., Pittsburgh** — Hunting Davis Co., Century Bldg., Archt., is preparing plans for the construction of a 10 story professional an doffice building, on Pennsylvania Ave. Estimated cost $600,000. Owners' name withheld.

**Pa., Spangler**—Northern Cambria Waterworks Co., J. A. McClain, Pres., Spangler, plans the construction of an impounding dam, to store 75,000,000 water, with pumping equipment, on Schirtf's run. Estimated cost $50,000.

**R. I., Newport** — Newport Community Hotel Assn., plans the construction of a hotel at Bellevue and Touro Sts. Estimated cost $500,000. Thomas, Martin & Kirkpatrick, Otis Bldg., Philadelphia, Pa., are architects.

**Tenn., Knoxville**—General Building Co., Inc., awarded contract for the construction of a 14 story office building at Market and Clinch Sts., to Worsham Bros., Empire Blvd. Estimated cost $700,000.

**Tenn., Nashville** — Bennie-Dillion Co., W. W. Dillion, Pres., Stahlman Bldg., awarded contract for the construction of the first unit of 12 story office building at 7th and Church Sts., to E. Holladay Construction Co., 9th Ave., North. Estimated cost $750,000.

**Tenn., Nashville**—Independent Order of Odd Fellows, c/o W. M. Hannah, Secy., Memphis, will soon receive bids for the construction of a 12 story lodge and office building, for the Tennessee State Lodge, at 119 7th St., here. Estimated cost $1,000,000.

**Tex., Lometa**—City voted $42,000 bonds for the construction of a waterworks system, including wells, pumping equipment, etc. A. E. McLean, is Mayor.

**Tex., Mexia**—Mexia Ice Co., T. A. Phillips, Mgr., awarded contract for the construction of a 35 ton capacity ice plant, and will install $50,000 worth of machinery.

**Tex., Temple**—City, H. J. Graese, Mgr., plans an election April 6th, to vote $50,000 bonds for waterworks improvements, including new pumping equipment, etc. Engineer not selected.

**Va., Ashland**—S. R. Carter, Pres., and C. H. Bosshen, Vice-Pres. of company recently chartered, plan to remodel a building and install machinery for the manufacture of ice in plant here. Estimated cost $40,000.

**Wis., Fond du Lac**—Bd. of Public Works, J. F. Hohensee, Secy., will receive bids until April 2 for the construction of a 44 x 160 ft. addition to pumping station. J. E. Hennen, North Main St., is engineer.

**Man., Winnipeg**—Harris Abbatoir Co., Ltd., Union Stock Yards, Toronto, Ont., awarded contract for the construction of a packing plant. Estimated cost $400,000. Owners will purchase $500,000 equipment, including steam boilers, engines, elevators, motors, refrigeration and artificial ice equipment, incinerators, tanks, etc.

**Ontario**—Hydro Electric Commission, 190 University Ave., Toronto, will investigate and prepare report on proposed water power development in Leeds County, on the Calaraqui River, to develop 5,000 hp. Estimated cost $750,000. F. A. Gaky, 190 University Ave., Toronto, is commission engineer.

**Ont., Leamington**—Town, P. M. Seekirk, Clk., plans the construction of additions to waterworks system, including pumphouse with 2 electric driven, centrifugal pumps, etc. Estimated cost $25,000. Engineer not selected.

**Ont., Mulock**—W. Holden Lumber Co., Mulock Station, Toronto and Northern Railway, is in the market for 100 hp. stationary steam boiler.

**Que., Montreal**—Kerry & Chase, Ltd., Engrs., 550 Confederation Life Bldg., Toronto, Ont., are in the market for a 220 hp. turbine, 8½ ft. head, and a belt driven generator for the Canadian Paperboard Co., 2 Seigneeurs St., Montreal, mill here.

**N. Z., Auckland** — Auckland Electric Power Board, will receive bids until May 25, for electric crane, rotary converters, transformers, and rotary balancers.